MISSOURI HAZARD ANALYSIS

Prepared by:

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STATE OF MISSOURI
P.O. BOX 116
JEFFERSON CITY, MO 65102

December 2013

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PREFACE

The Missouri State-wide Hazard Analysis is the result of the collective efforts of all the branches of SEMA. This analysis assesses various risks facing the state and its communities so that the risks can be evaluated and ranked. This process is then used to characterize hazards for emergency planning. It estimates the probability of occurrence and the severity of consequences for each hazard and provides a method of comparison.

State agencies and local jurisdictions should use this hazard analysis for planning, prioritization, and resource allocation. The information contained herein should identify capabilities essential to disaster response; for determining the probable effectiveness of allocating resources in emergency situations; and for encouraging the cooperation of various political subdivisions and emergency services in formulating regulations, plans and programs in order to mitigate disasters and minimize loss of life, human suffering, and damage to public and private property.

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PURPOSE

The emergency management community now faces threats in many ways different than past threats. Gone are the days when emergency management was only for natural disasters and nuclear preparedness. We now face more technologically and politically based hazards that demand the attention of the emergency management community. These new hazards include a number of threats that have not been adequately dealt with in the past, including hazardous materials releases, civil disorders, and terrorism.

This document has been compiled to identify the multiplicity of hazards that exist at varying locations and degrees of magnitude throughout the state and to determine the potential impacts of these hazards on residents, property, and the environment. The information contained herein identifies capabilities essential to disaster response, for determining the probable effectiveness of allocating resources in emergency situations, and for encouraging the cooperation of various political subdivisions and emergency services in formulating regulations, plans, and programs to prepare for disasters and minimize loss of life, human suffering, and damage to public and private property. In addition, a thorough hazard analysis provides a foundation for educating senior government officials and the public on dangers posed by various hazards.

This Hazard Analysis assesses various risks facing the state and its communities in order to evaluate and rank them. This process is then used to characterize hazards for emergency planning. It estimates the probability of occurrence and the severity of consequences for each hazard and provides a method of comparison. The evaluation involves many interrelated variables (toxicity, demographics, topography, etc.), and should be used by state and local officials in planning and prioritizing allocation of resources.

The hazards presented here are those that have been experienced by, or pose a potential threat to, Missourians. However, local or isolated problems that constitute potential disasters should not be overlooked.

The following definitions explain the ratings for each hazard:

Probability: The likelihood that the hazard will occur.

Low	The hazard has little or no chance of happening.
Moderate	The hazard has a reasonable probability of occurring.
High	The probability is considered sufficiently high to assume that the event will occur.

Severity: The deaths, injuries, or damages (property or environmental) that could result from the hazard.

Low	Few or minor damages or injuries are likely.
Moderate	Injuries to personnel and damages to property and the environment is expected.
High	Deaths and major injuries and damages will likely occur.

The hazards covered in the analysis are listed below, along with the overall rating they were given. The ratings presented below are situational dependent.

Tornadoes/Severe Thunderstorms
Probability: High
Severity: High

Dam Failures
Probability: Low
Severity: Moderate

Heat Wave
Probability: Moderate
Severity: Moderate

Severe Winter Weather/Snow/Ice/Severe Cold
Probability: High (North of Missouri River)
Probability: Low (South of Missouri River)
Severity: Moderate (North of Missouri River)
Severity: Moderate (South of Missouri River)

Attack
(Nuclear/Conventional/Chemical/Biological)
Probability: Low
Severity: High

Utilities (Interruptions and System Failures)
Probability: High
Severity: Low

Public Health Emergencies/Environmental Issues
Probability: High
Severity: Moderate to High

Nuclear Power Plants (Emergencies/Accidents)
Probability: Moderate
Severity: Moderate

Floods (Major and Flash)
Probability: High
Severity: High

Special Events
Probability: Low
Severity: Low to High

Drought
Probability: Moderate
Severity: Moderate

Earthquakes
Probability: High
Severity: High

Fires
(Structural & Urban)
Probability: High
Severity: Moderate

(Wild)
Probability: Moderate
Severity: Low to Moderate

Terrorism
Probability: Low
Severity: Low to High

Mass Transportation Accidents
Probability: Moderate
Severity: Moderate

Hazardous Materials
(Fixed Facility Accidents)
Probability: Moderate
Severity: Moderate

(Transportation Accidents)
Probability: High
Severity: Moderate

Civil Disorder
Probability: Low
Severity: Low to High

INTRODUCTION

Because Missouri is located in the middle section of the United States, it is prone to several kinds of natural hazards. Missouri has a continental climate; in other words, the weather is changeable and has large variations in temperature and precipitation.

Missouri serves as a major thoroughfare for transportation and has an abundant share of industrial, agricultural, and recreational facilities. Thus, man-made disasters can occur, such as hazardous materials releases, fixed nuclear facility incidents, and other emergencies caused by human action.

Missouri has four topographically distinct regions: glaciated plains in the north, plains or prairie in the west, lowlands in the extreme southeast, and the Missouri Ozarks in between.

The plains section, both glaciated and unglaciated, encompasses nearly all the area north of the Missouri River and a large area south of the river in the western part of the state. The topography varies from rolling hills in the east to hills in the west that average about 450 feet above sea level. There are numerous wide, flat valleys cut by the river.

The Ozarks, which comprise about half of the state, are characterized by rugged areas of sharp ridges and deep narrow valleys. Elevations range from about 1,000 to more than 1,600 feet above sea level.

The southeastern lowlands cover about 3,000 square miles, with elevations from 230 to 300 feet above sea level. Much of the region is excellent farmland, channeled by an extensive system of drainage ditches.

Because the state is situated along two of the continent's greatest rivers, the Missouri and the Mississippi Rivers, the potential for great floods is high. While six large flood control dams have been built on the mainstream of the Missouri River, they have not eliminated the flood threat.

Warm and cool air masses often collide along sharply divided "fronts," accompanied by violent thunderstorms having intense rains, strong winds, hail, and occasional tornadoes. These frontal storm systems can pass across the state at any time of the year, but are most frequent during the spring months (March, April and May). There are two important truths about Missouri's weather: (1) the state is subject to weather extremes, and (2) extreme weather changes can occur rather quickly.

Most of the natural disasters that occur in Missouri (except for earthquakes, land subsidence, and possibly dam failures) result from a weather extreme or an extreme weather change. Because Missouri is situated in the center of the United States, it is subject to many different influences that determine weather patterns.

According to Dr. Grant Darkow [1], Department of Atmospheric Science at the University of Missouri-Columbia, specific recognizable weather patterns are responsible for Missouri's weather, especially those that "tend to produce extremes in precipitation, resulting in unusually wet or drought conditions, and extremes in temperature, either abnormally warm or cold." Darkow explains, "The character of air over Missouri on any particular day or series of days is dominated by the source regions from which it comes. Missouri's mid-continental location makes it subject to air flows from a variety of source regions with markedly different properties.

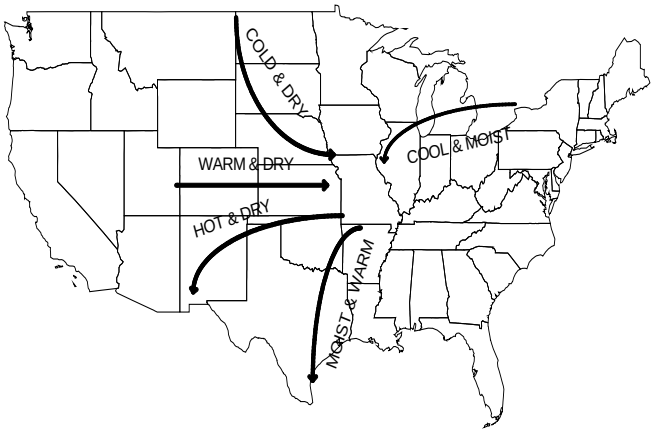
The state is close enough to the Gulf of Mexico that warm air with high humidity can flow into the state from a southerly direction at almost any time of the year. This warm, moist air is the principal source of spring, summer, and fall precipitation and, occasionally, precipitation in winter as well.

In contrast, air arriving over Missouri from semi-arid to arid regions to the southwest is warm or hot and usually dry. Air that has moved from west to east over the Rocky Mountains arrives warm and dry, having lost most of its low-level moisture as it climbed the west side of the mountains.

Abnormally cold air in the winter and cold summer air with only very small moisture content arrives over Missouri from the northwest or north, whereas air entering Missouri from the northeast will tend to be cool and moist." (see Figure 1)

FIGURE 1

SOURCE REGIONS AND ATMOSPHERIC CHARACTERISTICS FOR AIR ARRIVING IN MISSOURI



Darkow goes on to explain, "Normally, the flow from one of the principal source regions will last for two or three days before switching to a different direction and source region. These transitions typically are accompanied by a frontal passage during which the change in wind direction, temperature, and moisture content, or any combination, is concentrated."

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[1]Grant L. Darkow, Missouri Weather Patterns and Their Impact on Agriculture, University Extension, University of Missouri-Columbia.

"In some instances, however, a particular flow pattern may be very persistent or dominant for a period of weeks or even months. These periods can lead to wet, dry, hot, or cold spells, and the extremes associated with these periods. These periods are characterized by particular upper air flow patterns and associated surface weather patterns." (see Figures 2a, 2b, 3a, 3b, 4a, and 4b).

Figure 2a. Upper Air Pattern (Precipitation Producing)

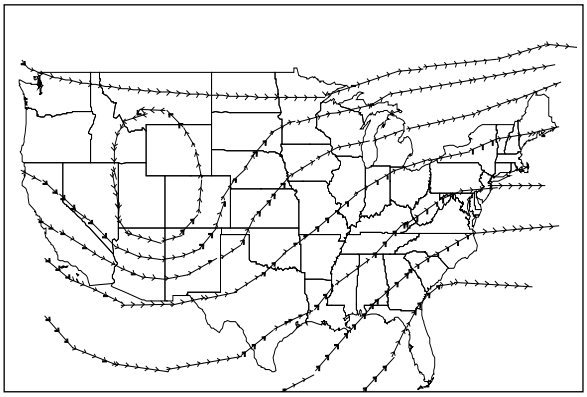


Figure 2b. Surface Air Pattern (Precipitation Producing)

Figure 3a. Upper Air Pattern (Dry To Drought Producing)

Figure 3b. Surface Air Pattern (Dry to Drought Producing)

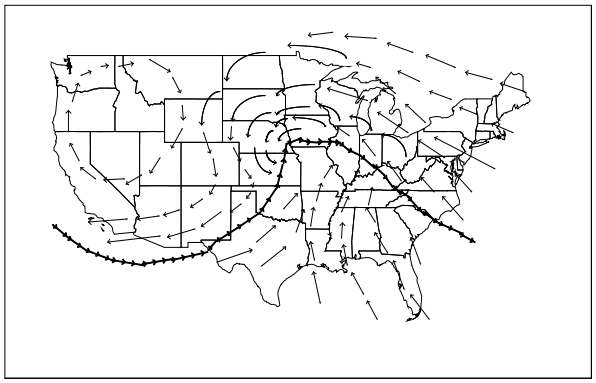


Figure 4a. Upper Air Pattern (Cold-Dry Case)

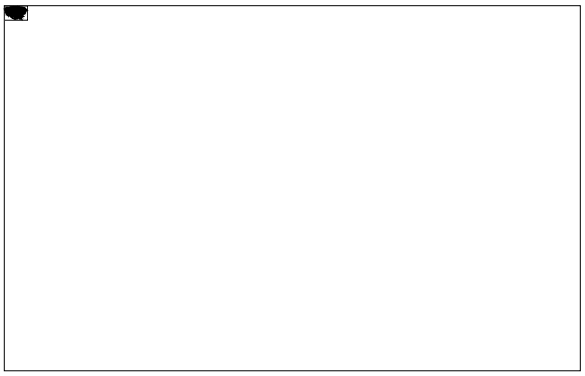


Figure 4b. Surface Air Pattern (Cold-Dry Case)

"The persistence of these weather patterns and the possible resulting condition is the subject of several of the natural disasters discussed in this study. Specifically, floods, droughts, fires, heat waves, severe cold, and winter storms can be the result of the persistence of one of these weather patterns, whereas tornadoes can represent the outgrowth of rapid shifts in weather patterns. Knowing these patterns may assist in alerting disaster planners and the general public to the possibility of a developing emergency situation."

The Missouri State Emergency Operations Plan considers natural and man-made disasters, as discussed below.

NATURAL DISASTERS: Natural disasters can be complex, occurring with a wide range of intensities. Some events are instantaneous and offer no window of warning, such as earthquakes. Some offer a short window in which to alert the public to take actions, such as tornadoes or severe thunderstorms. Others occur less frequently and are typically more expansive, with some warning time to allow the public time to prepare, such as flooding. The following natural disasters may threaten Missouri:

- Tornadoes
- Floods
- Water (Interruptions and Drought)
- Earthquakes/Land Subsidence
- Wild Fires (Forest, Prairie, and Grasslands)
- Winter Storms and Severe Cold
- Heat Wave
- Severe Weather.

MAN-MADE DISASTERS: Each year sees an increase in man-made incidents, which can be just as devastating as natural disasters. The following man-made disasters could affect the State of Missouri:

- Structural and Urban Fires
- Utilities (Interruptions and Failures)
- Fixed Facility and Transportation Nuclear Hazards
- Hazardous Materials; Other Environmental Issues
- Mass Transportation Incident
- Nuclear Attack
- Conventional Attack
- Biological and Chemical Attack
- Terrorism
- Sabotage
- Civil Disorder
- Dam Failure
- Public Health Emergencies.

This hazard analysis addresses these man-made disasters.

In the U.S., 95 percent of all presidentially-declared disasters have been related to weather or flood events. In Missouri, 100 percent of the presidentially-declared disasters since 1975 have also been related to weather or flood events.

Table 1 summarizes presidentially-declared disasters in Missouri since 1975.

TABLE 1

PRESIDENTIAL DISASTER DECLARATIONS FOR MISSOURI SINCE 1975

Declaration Date	Incident Type	No. Of Counties Designated	Type of Assistance By County*
May 3, 1975	Tornadoes, High Winds, Hail	4	IA & PA: 4
July 21, 1976	Severe Storms, Flooding	4	IA & PA: 4
September 24, 1976	Drought	94	PA Only: 94
May 7, 1977	Tornadoes, Flooding	7	IA & PA: 7
September 14, 1977	Severe Storms, Flooding	6	IA & PA: 6
March 12, 1979	Ice Jam, Flooding	2	PA Only: 2
April 21, 1979	Tornadoes, Torrential Rains, Flooding	17	IA Only: 1
			IA & PA: 16
May 15, 1980	Severe Storms, Tornadoes	1	IA Only: 1
August 26, 1982	Severe Storms, Flooding	3	IA Only: 1
			IA & PA: 2
December 10, 1982	Severe Storms, Flooding	17	IA Only: 18
			PA Only: 1
			IA & PA: 5
June 21, 1984	Severe Storms, Flooding	11	IA Only: 1
			PA Only: 8
			IA & PA: 2
October 14, 1986	Severe Storms, Flooding	30	IA Only: 7
			PA Only: 15
			IA & PA: 8
May 24, 1990	Severe Storms, Flooding	10	IA Only: 2
			IA & PA: 8
May 11, 1993	Severe Storms, Flooding	8	IA Only: 8
July 9, 1993	Severe Storms, Flooding	102	IA Only: 14
			IA & PA: 88
			(Cities) IA & PA: 3
December 1, 1993	Severe Storms, Tornadoes, Flooding	24	IA Only: 10
			IA and PA: 14
April 21, 1994	Severe Storms, Tornadoes, Flooding	18	IA Only: 18
June 2, 1995	Severe Storms, Tornadoes, Flooding	61	IA Only: 18
			IA & PA: 43
			(Cities) IA Only: 1

Declaration Date	Incident Type	No. Of Counties Designated	Type of Assistance By County*
October 14, 1998	Severe Storms, Flash Flooding	19	IA and PA: 5
			PA Only: 14
Oct. 19, 1998**	Severe Storms, Flash Flooding	2	IA Only: 2
			(Cities) IA Only: 1
April 20, 1999	Storms and Flooding	6	IA Only: 6
May 12, 2000	Thunderstorms, Flooding	10	IA: 10 IA and PA: 3
February 6, 2002	Ice Storm	43	IA Only: 43
			PA Only: 22
			IA and PA: 26
May 6, 2002	Severe Storms, Tornadoes	79	IA Only: 9
			PA Only: 31
			IA and PA: 39
May 6, 2003	Thunderstorms, Tornadoes, Flooding	76	IA Only: 42
			PA Only: 2
			IA and PA: 32
June 11, 2004	Tornado, Severe Storms, Flooding	37	IA: 37
September 10, 2005	Hurricane	114 & City of St. Louis	PA Only
March 16, 2006	Severe Storms, Tornadoes, Flooding	41	IA Only: 12
			PA Only: 8
			IA and PA: 21
April 5, 2006	Severe Storms, Tornadoes, Flooding	7	IA Only: 3
			IA and PA: 4
July 21, 2006	Severe Storms EM-3267	7 & City of St. Louis	PA Only
November 2, 2006	Severe Storms DR-1667	City of St. Louis	PA Only
December 29, 2006	Severe Winter Storms DR-1673	13 & City of St. Louis	PA Only
January 15, 2006	Severe Winter Storms/Flooding DR-1676	37 & City of St. Louis	PA Only
June 11, 2007	Severe Storms/Flooding DR-1708	30	6 – IA 12 – PA 12 – IA & PA
September 21, 2007	Severe Storms/Flooding DR-1728	7	PA Only
December 27, 2007	Severe Winter Storms DR-1736	42	PA Only
February 5, 2008	Severe Storms/Tornado/Flooding DR-1742	9	PA Only
March 12, 2008	Severe Winter Storms/Flooding DR-1748	18	PA Only
March 19, 2008	Severe Storms/Flooding DR-1749	56	35 – IA, 51 – PA 30 IA & PA 5 – IA only 21 – PA only
May 23, 2008	Severe Storms/Tornado DR-1760	3	IA Only
June 25, 2008	Severe Storms/Flooding DR-1773	53	3 – IA only 26 – PA only 24 – IA & PA

Declaration Date	Incident Type	No. Of Counties Designated	Type of Assistance By County*
November 13, 2008	Severe Storms, Flooding, and a Tornado/DR-1809	56	7 - IA Only 37 – PA Only 12 – IA & PA
February 17, 2009	Severe Winter Storms/DR-1822	21	PA Only
June 19, 2009	Severe Storms, Tornadoes and Flooding/DR-1847	52	4 - IA Only 24 – PA Only 24 – IA & PA
August 17, 2010	Severe Storms, Flooding and Tornadoes DR-1934	37	PA-Only
`March 23, 2011	Severe Winter Storm and Snowstorm DR-1961	62	PA Only
May 9, 2011	Severe Storms, Tornadoes, and Flooding/DR-1980	41	3 – IA Only 16 – PA Only 22 – IA & PA
August 12, 2011	Flooding/DR-4012	11	6 – IA Only 5 – PA Only 6 – IA & PA
July 18, 2013	Severe Storms, Straight-Line Winds, Tornadoes, and Flooding/DR-4130	27	27 – PA Only
September 6, 2013	Severe Storms, Straight-Line Winds, and Flooding/DR-4144	18	18 – PA Only

Notes:
* IA denotes individual assistance; PA denotes public assistance.
** Declaration was for incident in July 1998, and approved October 19, 1998, following State appeal.

Table 2 shows the total amount of Public Assistance eligible for disaster declarations in Missouri from 1990 through December 2013. Public assistance includes state and federal assistance for uninsured losses to eligible public property and infrastructure within those counties included in the disaster declaration.

TABLE 2

PUBLIC ASSISTANCE FOR MISSOURI DISASTERS, 1990-2011

Date	Disaster Relief No.	Number of Applicants	Damage Survey Reports/Project Worksheets	Total Amount Eligible
Spring 1990	DR-0867	72	2,023	$9,461,555.00
Summer 1993	DR-0995	901	14,479	$140,859,657.00
Fall 1993	DR-1006	38	565	$3,281,066.00
Spring 1995	DR-1054	329	2,275	$17,404,027.00
Fall 1998	DR-1253	104	869	$11,217,783.00
May 12, 2000	DR-1328	31	183	$3,359,091.75
February 6, 2002	DR-1403	247	654	$64,117,837.60
May 6, 2002	DR-1412	338	1679	$47,657,061.62
May 6, 2003	DR-1463	160	552	$21,494,879.54
September 10, 2005	EM-3232	12	22	$1,810,673.71
March 16, 2006	DR-1631	129	249	$7,087,060.37
April 5, 2006	DR-1635	28	110	$8,611,859.32

July 21, 2006	EM-3267	132	70	$2,727,282.97
November 2, 2006	DR-1667	3	11	$882,436.00
December 29, 2006	DR-1673	144	273	$8,661,384.00
January 15, 2007	DR-1676	438	1122	$147,627,257.00
June 11, 2007	DR-1708	211	724	$10,603,783.00
September 21, 2007	DR-1728	19	301	$7,560,744.00
December 27, 2007	DR-1736	260	721	$34,453,812.00
February 5, 2008	DR-1742	44	99	$1,799,103.00
March 12, 2008	DR-1748	91	225	$13,964,500.00
March 19, 2008	DR-1749	306	2061	$36,800,000.00
June 25, 2008	DR-1773	308	1295	$29,500,000.00
November 13, 2008	DR-1809	168	472	$11,503,934.68
February 17, 2009	DR-1822	218	627*	$136,123,253.47*
June 19, 2009	DR-1847	199*	780*	$26,993,952.79*
August 17, 2010	DR-1934	247	1236*	$17,310,685.19*
March 23, 2011	DR-1961	548*	943*	$9,519,674.43*
May 9, 2011	DR-1980	239*	2005*	$142,206,835.44*
August 12, 2011	DR-4012	122*	577*	$25,944,445.41*
July 18, 2013	DR-4130	129**	118**	$306,272.74**
September 6, 2013	DR-4144	76**	13**	$0.00**
	Totals	6291*	37,333*	$1,000,851,908.03*

Notes:
DR Disaster Declaration
EM Emergency Declaration
* Figures as of October 29, 2013
**Figures as of November 1, 2013

Table 3 shows the total amount of individual assistance for individual assistance (IA)-declared disasters in Missouri from 1990 through 2011. Individual assistance includes state and federal assistance to individuals and families for uninsured losses within those counties included in the disaster declaration.

TABLE 3

INDIVIDUAL ASSISTANCE FOR MISSOURI DISASTERS, 1990-2011

Date	Disaster Relief No.	Individual Assistance	Total Number of Applicants
Spring 1990	DR-867	$4,000,000.00	700
Spring 1993	DR-989	$1,591,241.00	447
Summer 1993	DR-995	$65,690,976.00	15,478
November 1993	DR-1006	$2,796,562.00	673
Spring 1994	DR-1023	$2,116,639.00	779
Spring 1995	DR-1054	$4,297,039.00	1,868
July 1998	DR-1256	$1,093,865.00	1,763
Fall 1998	DR-1253	$1,251,679.00	1,623
Spring 1999	DR-1270	$559,725.00	203

May 12, 2000	DR-1328	$2,897,685.96	515
February 6, 2002	DR-1403	$3,656,665.11	8,376
May 6, 2002	DR-1412	$8,774,608.35	6,834
June 11, 2004	DR-1524	$1,383,742.88	1,209
March 16, 2006	DR-1631	$1,533,976.15	2,312
April 5, 2006	DR-1635	$2,470,813.97	152
June 11, 2007	DR-1708	$2,426,120.00	928
March 19, 2008	DR-1749	$13,677,398.00	6067
May 23, 2008	DR-1760	$1,601,645.00	584
June 25, 2008	DR-1773	$4,907,322.00	2081
November 13, 2008	DR-1809	$6,753,062.64	3,639
June 19, 2009	DR-1847	$5,417,824.37	1,241
May 9, 2011	DR-1980	$37,115,639.63*	6,448*
August 12, 2011	DR-4012	$3,145,110.51*	457*
	Totals	$179,159,340.57*	64,834*

Notes:
* Figures as of October 29, 2013
Table 4 shows the most expensive Presidentially-Declared Disasters

TABLE 4

MOST EXPENSIVE PRESIDENTIALLY-DECLARED DISASTERS

Disaster Incidents	**Declaration Date**	**FEMA Funding in Billions of dollars**
Hurricane Katrina	October 2005	$29,318,576,948**
Attack on America	September 2001	$8,818,350,120*
Northridge Earthquake	January 1994	$6,978,325,877*
Hurricane Rita	September 2005	$3,749,698,351*
Hurricane Ivan	September 2004	$2,431,034,355*
Hurricane Georges	October 1998	$2,245,157.178*
Hurricane Wilma	September 2005	$2,110,738,364*
Hurricane Charley	August 2004	$1,885,466,628*
Hurricane Andrew	August 1992	$1,813,594,813*
Hurricane Frances	September 2004	$1,773,440,505*
TOTAL		$58,881,471,118*

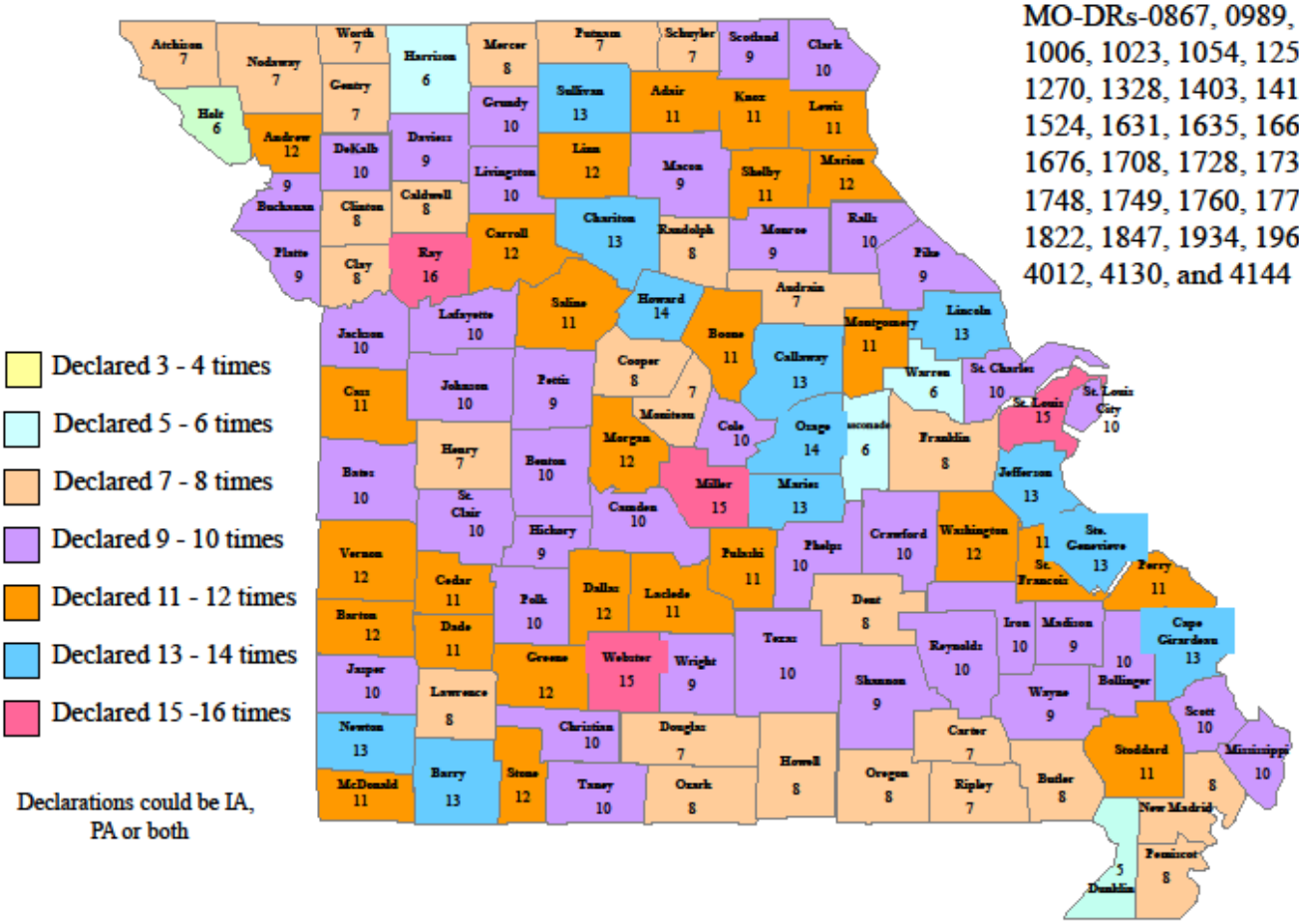
Note: Numbers are in actual dollars, not adjusted for inflation.

*Figures as of December 6, 2012

** Approximately 68% funded.

Declared Disasters
Individual and Public Assistance
1990 - Present

Missouri Disaster Declarations
1990 thru Present



Counties Designated (IA, PA, or Both) in Missouri
MO-DRs-0867, 0989, 0995, 1006, 1023, 1054, 1253, 1256, 1270, 1328, 1403, 1412, 1463, 1524, 1631, 1635, 1667, 1673, 1676, 1708, 1728, 1736, 1742, 1748, 1749, 1760, 1773, 1809, 1822, 1847, 1934, 1961, 1980, 4012, 4130, and 4144

Updated October 2013

FOREWORD

Lately, disasters appear to be occurring more frequently than during previous years. Federal, state, and local emergency managers need to prepare for, respond to, and recover from the increasing frequency and scope of disasters. While recent major disasters are memorable, the increased rate of occurrence is remarkable. Disasters in the 1980s were nearly twice as frequent as disasters in the 1970s. From 1993 through 2000 alone, Missouri experienced seven flood disasters, including one that exceeded the once-in-every–500-years flood levels. In the decade 2000-2010, Missouri received 25 federal disaster declarations. From January-September 2011, Missouri has had three major disaster declarations so far. According to some weather forecasters, the country has entered a period of extremely destructive weather patterns.

The foundation for emergency preparedness is planning how to handle disasters. The art of perfecting how to respond to disasters is enhanced by the ability to bring together the key players for periodic exercises that emulate actual disasters.

This Hazard Analysis should be used by state and local officials to plan and prioritize resource allocations. Local officials can use information in this document to develop their own localized hazard analysis.

POPULATION

Missouri has a surface land area of 68,741.52 square miles and a population of 5,988,927 (2010 census).

Missouri ranks 18th among the 50 states in population; 18th in land area, and 28th in population density with 87.1 persons per Square Mile. Within the state are 1032 incorporated cities, towns, and villages.

In the 1830 census, it's first, Missouri had a population of 140,455. The 1970 census showed 4,677,623 inhabitants, and the 1980 census showed 4,917,444 residents; in 1990, the census indicated another population increase to 5,117,073; in 2000 the census showed 5,595,211 inhabitants, and the 2010 census increased to 5,988,927.

The population center of the United States was determined to lie in Phelps County approximate 2.8 miles east of Edgar Springs.

Missouri Population 5,988,927

Land Area Square Miles 68,741.52

Population Equivalent per Square Mile 87.1

Number of Incorporated Cities, Towns, and Villages 1032

Number of Counties and the City of St. Louis 115

Urban Population 4,218,371 (70.4%)

Cities with a Population of 50,000 or More 13

Counties with a Population Greater than 500,000 2
(St. Louis and Jackson)

Counties with a Population of 100,000 to 500,000 8
(Boone, Clay, Franklin, Greene, Jasper, Jefferson, St. Louis City, St. Charles)

Counties with a Population of 50,000 to 100,000 12
(Buchanan, Cape Girardeau, Cass, Christian, Cole, Johnson,
Lincoln, Newton, Platte, Pulaski, St. Francois, and Taney)

Counties with a Population of 25,000 to 50,000 23

Counties with a Population of 15,000 to 25,000 26

Counties with a Population of 10,000 to 15,000 18

Counties with a Population of 1 to 10,000 ..... ….26

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U.S. Census Bureau, 2010 Census. 2010 Census National Summary File of Redistricting Data, Table P1; Summary File 1, Table GCT-PH1
Online Address: http://www.census.gov/2010census/

Office of Budget and Planning – 2010 Census Counts. Online Address:
http://oa.mo.gov/bp/2010CensusData.htm

Federal Emergency Management Agency (FEMA). Online Address:
http://www.fema.gov/disasters
http://thexodirectory.com/2008/01/most-expensive-presidentially-declared/

ANNEX A
TORNADOES AND SEVERE THUNDERSTORMS
(DOWNBURSTS, LIGHTNING, HAIL, HEAVY RAINS, WIND, FLASH FLOODING)

I. TYPE OF HAZARD

Tornadoes and Severe Thunderstorms (Downbursts, Lightning, Hail, Heavy Rains, Wind, Flash Flooding)

II. DESCRIPTION OF HAZARD

Tornadoes are violently rotating columns of air produced by a severe thunderstorm that occur most frequently in the Midwestern areas of the United States. Weather conditions conducive to produce thunderstorms that can have a tornado often produce a wide range of other dangerous storm activities, including damaging straight-line winds, lightning, hail, and heavy rains that lead to flash flooding. For the purpose of this analysis, tornadoes are considered in one category. Other severe weather activities, noted above, are referenced separately in the Synopsis section of this annex (see Part VI).

Essentially, tornadoes are a rotating column of air with two components of winds. The first is the horizontal, rotational winds that can measure over 200 miles an hour, and the second is an uplifting current. It is the force of the horizontal wind that is responsible for the majority of damage that occurs with tornadoes. Although tornadoes have been documented in all 50 states, a higher percentage occurs in the central United States. The unique geography of the central United States allows for the development of thunderstorms that can spawn tornadoes. Warm, moist air flowing north from the southwestern U.S. collides with cold air flowing south from Canada.

Most tornadoes spawn from a thunderstorm know as a supercell. A supercell thunderstorm has a very strong updraft. The unique thing about the supercell is that the updraft also rotates in a counter clockwise direction. The rotation is caused by the change of the wind in speed and direction with height, which is called vertical wind shear. On days that supercells can form, the surface wind is typically from the south, but as you go up in height, the wind changes to a more southwest or westerly direction and it increases in speed. It is this particular change of the wind in speed and direction with height that generates the rotating updraft in a supercell. While the supercell is responsible for most tornadoes in the United States, tornados associated with squall lines account for the majority of the remainder.

A tornado is air. It is a violently rotating column of air associated with the updraft of a severe thunderstorm. The visible appearance can vary greatly depending in its strength and the debris or soil ingested into the updraft. Many tornadoes start as a rotating funnel shaped cloud above the ground, then become a tornado as the spinning column reaches the ground causing a rotating column of debris.

Strong tornadoes often appear as a large, dark mass of debris. Tornadoes can also become surrounded by rain, making them virtually impossible to Such as the infamous May 22, 2011 tornado that devastated Joplin, MO.
Tornadoes can last from a few minutes to an hour or so. The width of the tornado (its path of destruction) can vary from 50 yards to up to a mile wide. Most Missouri tornadoes are small and short lived.
Tornadoes are classified according to the EF- Scale (the original F – Scale was developed by Dr. Theodore Fujita, a renowned severe storm researcher). The Enhanced F- Scale attempts to rank tornadoes according to wind speed based on the damage caused (Table A-1).

TABLE A-1

A. Enhanced F Scale for Tornado Damage

Enhanced Fujita (EF) SCALE	
EF Number	**3 Second Gust (mph)**
0	**65-85**
1	**86-110**
2	**111-135**
3	**136-165**
4	**166-200**
5	**Over 200**

***** IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS:** *The Enhanced F-scale is a set of wind estimates (not measurements) based on damage.* Its uses three-second gusts estimated at the point of damage based on a judgment of various levels of damage to 28 indicators. These estimates vary with height and exposure. **Important**: The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.

The National Weather Service, 2007

TABLE A-2

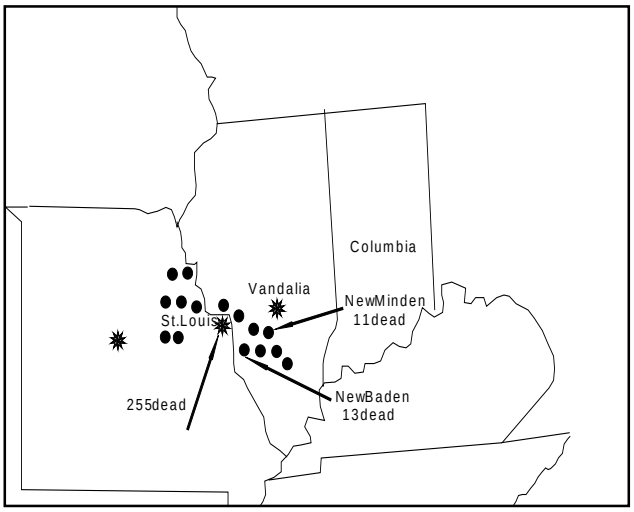
MISSOURI TORNADOES BY F-SCALE, 1950-2011

SCALE	PERCENTAGE
F0	51
F1	26
F2	13
F3	9
F4	1
F5	0

III. HISTORICAL STATISTICS

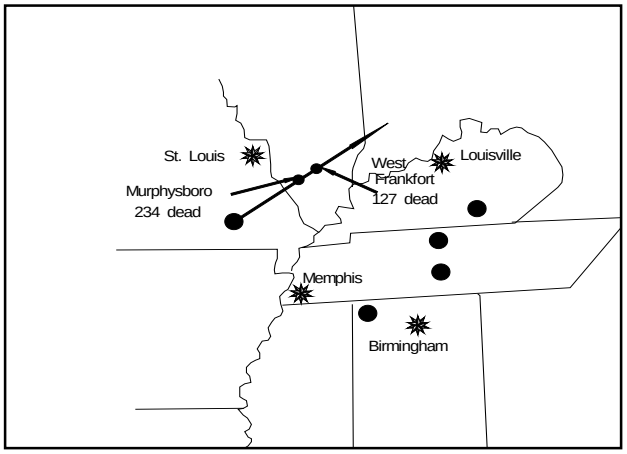
Historically, the State of Missouri has experienced numerous tornadoes of varied intensities. On May 27, 1896, between the hours of 2 and 8 p.m., a series of 18 tornadoes known as the "St. Louis, Missouri, Outbreak" struck Missouri and Illinois. These tornadoes resulted in 306 deaths and $15 million in damages (see Figure A-1).

Figure A-1
St. Louis, Missouri, Tornado Outbreak



The National Weather Service reported that 2,012 tornadoes had occurred in Missouri from 1950 to 2011, with 388 deaths and over $900 million in damages. This averages 32 tornadoes per year and 6 deaths per year.
There have been 848 total deaths since 1916.

Figure A-2
The Great Tri-State Tornado of 1925

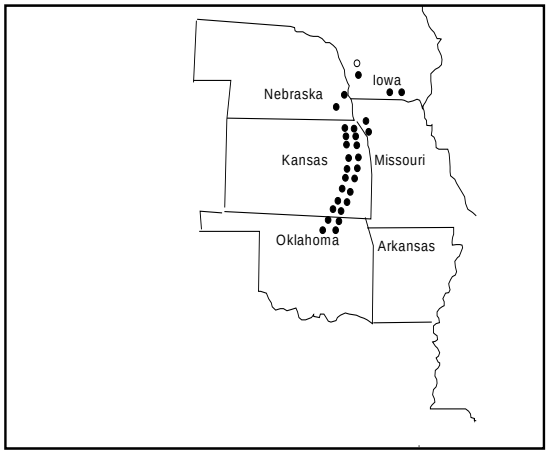


The worst tornado in U. S. history, in terms of deaths and destruction, occurred in Missouri on March 18, 1925, between 1 and 6 p.m. (see Figure A-2). The great "tri-state" tornado originated in Reynolds County. It proceeded east-northeast through the southern quarter of Illinois and into Indiana, covering 219 miles. It caused over $18 million in damage, affected six states, and killed 689 persons.

The City of Poplar Bluff, Missouri, was almost wiped out by a tornado on May 9, 1927. This tornado cost 92 lives and $2 million in damages. The same day, two severe tornadoes struck St. Louis, Missouri. The first tornado moved across the entire city from the western city limits to the Mississippi River through the Lafayette Park area, killing 306 people in Missouri and Illinois and causing almost $13 million in damages. The second tornado started in the southwestern part of the city and proceeded through the Tower Grove and Vanderventer areas, then on to Granite City, Illinois. Seventy-nine people were killed, and about $23 million in damages resulted from this storm.

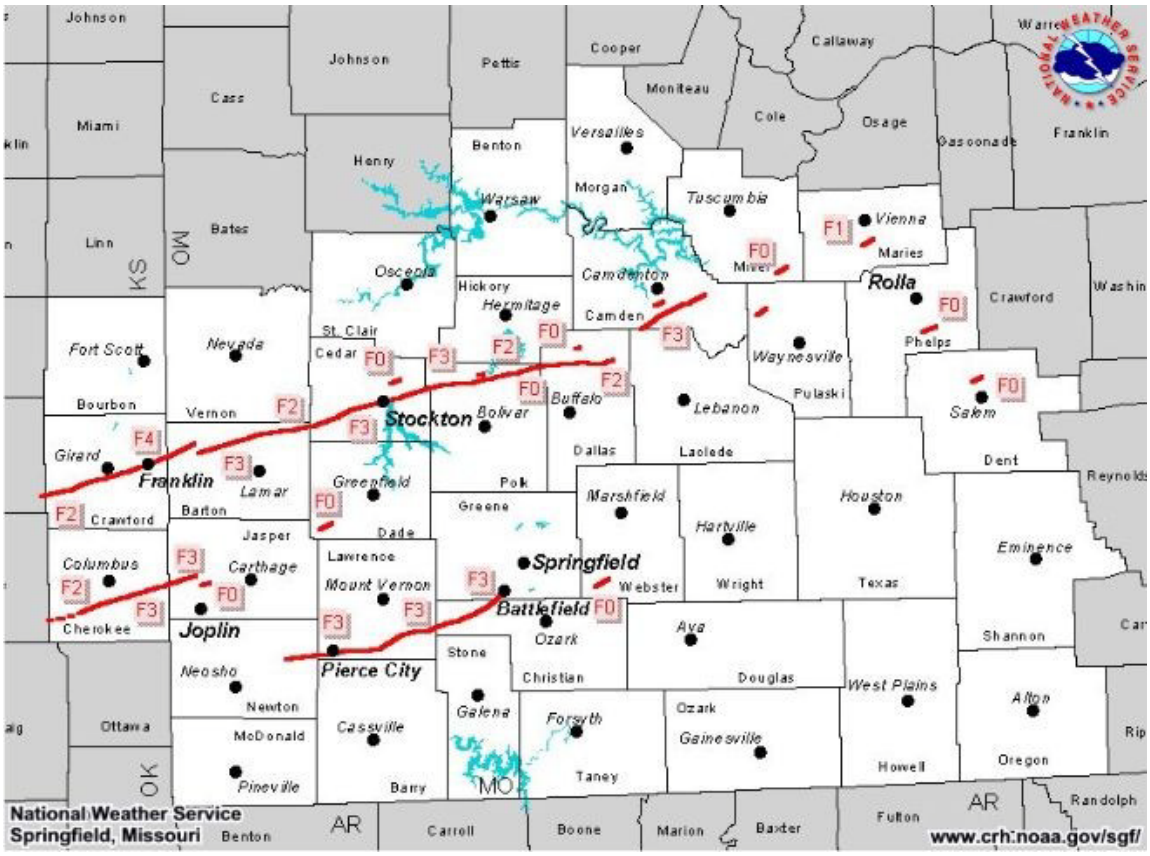
During the afternoon and evening of April 3, and the early morning of April 4, 1974, a "super outbreak" of 148 tornadoes across 13 states killed more than 300 people, injured more than 6,000 and caused $600 million in damages (see Figure 3).

Figure A-3
The Tornado Super Outbreak in 1974



On the afternoon of April 26, and the early morning of April 27, 1991, an outbreak of 54 tornadoes covering six states, including Missouri, resulted in 21 deaths, 308 injuries, and damages exceeding $277 million. There were two deaths in vehicles and 15 deaths in and near mobile homes.

On July 4, 1995, at approximately 5:40 p.m., a tornado struck the Randolph County community of Moberly. The initial touchdown of the storm was south of town. The storm then moved through the eastern half of the community. The tornado uplifted approximately 7 miles northeast of Moberly. At least 15 people were injured, 25 businesses damaged, along with the courthouse, and some 300 families affected. This resulted in a Small Business Administration disaster declaration for low interest loans. The tornado was characterized by the National Weather Service as a class F3 tornado.



May 4, 2003 Tornadoes

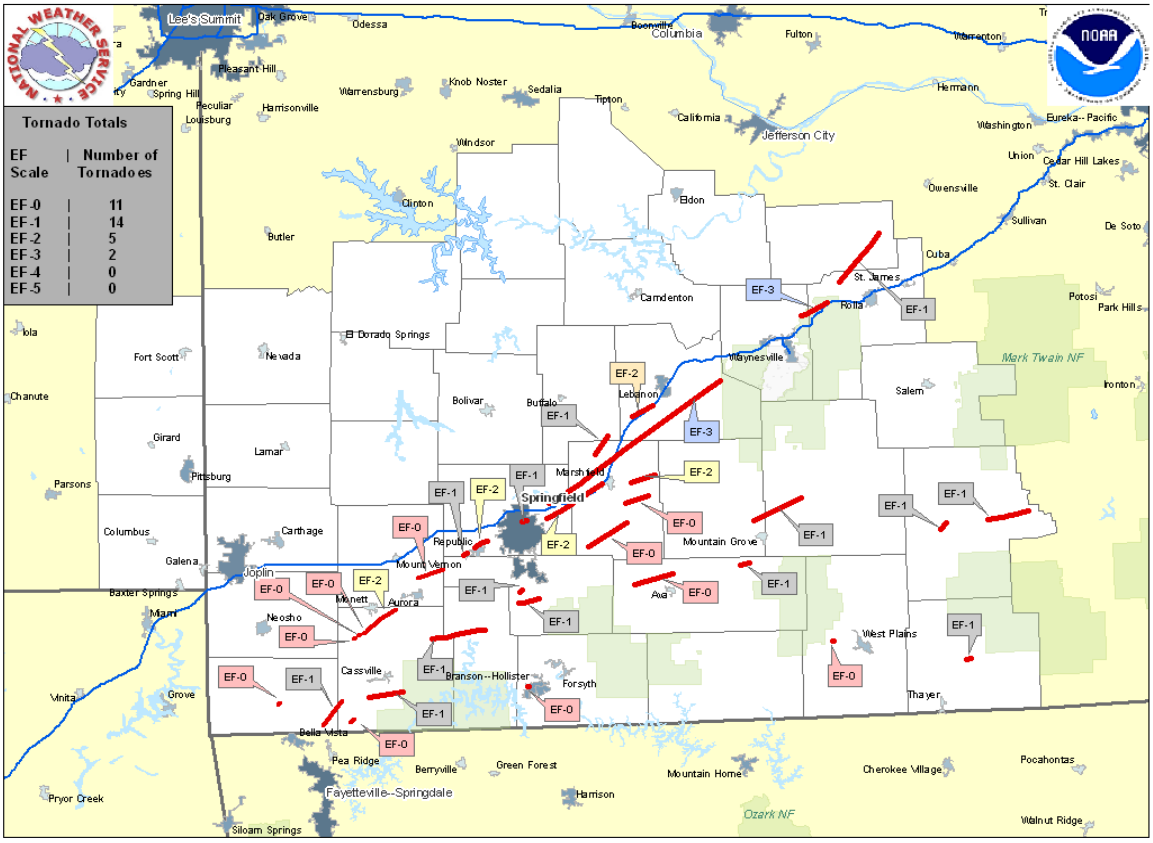
A record 84 tornadoes were recorded in Missouri in 2003. During the week of May 4, 2003, 79 of those tornadoes occurred and mostly in the southwest portion of Missouri. There were several F4 tornadoes which occurred on May 4 in Platt, Clay and Barton counties. There were nineteen people killed by the tornadoes in Southwest Missouri. That is the highest total since 1959 when 21 were killed. It is only the fourth year in which double digit deaths from tornadoes occurred in Missouri since 1950. The killer tornadoes all occurred on May 4th. The tornadoes which hit Newton, Lawrence, Christian and Greene counties killed 7 people. Five people were killed by a tornado which hit Cedar and Dallas counties. A tornado which hit Camden County killed 4 people, two people died from a tornado in Jasper County and one person died in Barton County. The tornadoes injured 171 people. That is the highest total since 310 were injured in 1957. See map in Figure A-5. This information provided by the NWS.

The 2003 record was short-lived, as a new record of 102 tornadoes was set in 2006. Beginning from March 8th – September 23rd, four sets of major storms went through the state. March 8 – 13 was declared DR 1631 by FEMA for IA and PA, March 30 – April 2 was declared DR 1635 by FEMA for IA and PA (Categories A and B), July 19 – 21 was declared DR 3267 for PA (Categories A and B), and September 22-23 is in the appeal process for declaration.

January 7-8, 2008 Tornado Outbreak

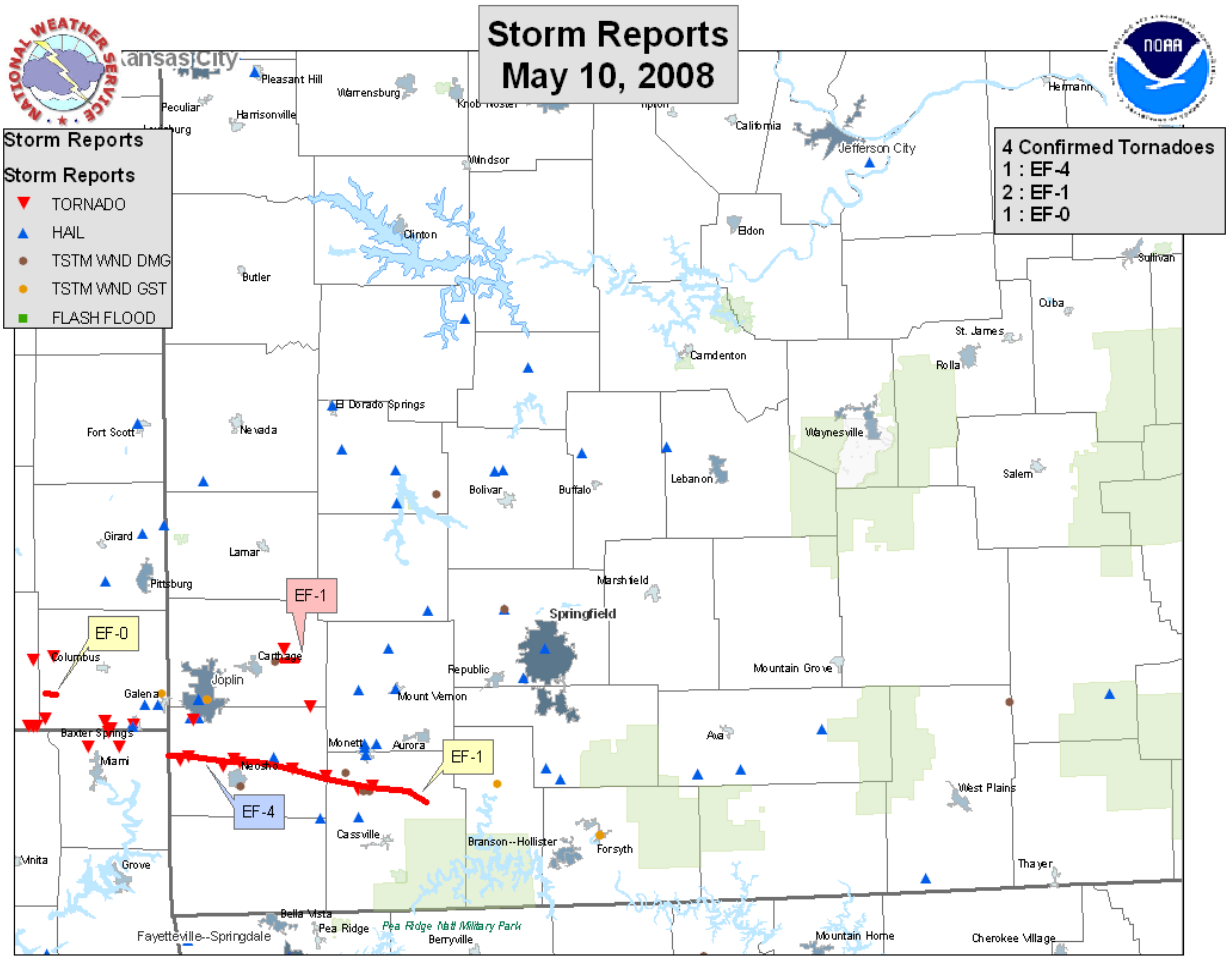
An unusually early severe weather outbreak hit the Missouri Ozarks Monday afternoon, January 7th, into the early morning hours Tuesday, January 8th, 2008. Numerous supercell thunderstorms spawned at least 29 tornadoes that resulted in significant damage to homes , trees and power lines. The supercell thunderstorms were followed by a violent squall line that produced damaging straight line winds in excess of 70 mph. In addition, the storms produced torrential rainfall and flash flooding. The storms developed as an intense storm system tracked out of the Rockies and interacted with an unseasonably warm, moist and unstable airmass across the Ozarks. Take a look at the **Severe Event Summary from the Storm Prediction Center** for a meteorological overview of the event.

National Weather Service Springfield, Missouri issued 33 severe thunderstorm warnings and 62 tornado warnings in approximately a 12 hour period. A total of 161 severe weather reports were received from mid afternoon on January 7th through the early morning hours on January 8th.



MAY 10, 2008....Tornadic Storms Hit Southeast Kansas and Southwest Missouri...

A strong area of low pressure lifted northeast out of southwest Missouri Saturday afternoon (5/10/08) and into central Missouri during the evening. Instability increased over southeast Kansas and the southwest corner of Missouri during the late afternoon as temperatures rose into the mid to upper 70s. The instability along with the strong cold front caused severe thunderstorms to develop. With strong wind shear in the area, the storms in this area quickly became tornadic along with producing large hail to the size of softballs. The tornadic systems were mainly concentrated in an area from Cherokee County, Kansas to Newton and Barry counties in Missouri.



Joplin Missouri EF-5 Tornado - May 22, 2011

A supercell thunderstorm tracked from extreme southeast Kansas into far southwest Missouri (NWS Springfield, County Warning Area) late Sunday afternoon and evening (May 22nd). This storm produced an EF-5 tornado over Joplin, Missouri resulting in devastating damage. This storm generated additional tornadoes and wind damage along its path as it moved southeast across far southwest Missouri. These storms also produced flash flooding across far southwest Missouri.

A large portion of Joplin Missouri was devastated by an **EF-5 (greater than 200 mph)** tornado resulting in **161 fatalities** and **over 1000 injured** in the Joplin MO area from this storm system. This tornado was ½ to ¾ miles wide and traveled approximately 13 miles. It touched down at the western edge of Joplin city limits and traveled on the ground throughout all the City to the eastern city limits, plus several miles into the City of Duquesne. There were an estimated 7,500 residential dwellings damaged by this storm, with 585 households needing temporary housing, 1,308 pets displaced by this tornado with 529 returned to their owners. More than 500 businesses were affected by this tornado with 4,500 to 5,000 employees in Joplin affected.

The Joplin tornado is the deadliest since modern recordkeeping began in 1950 and is ranked 8th among the deadliest tornadoes in U.S. history.

Sources: http://www.noaanews.noaa.gov/2011_tornado_information.html and Fact Sheet - City of Joplin May 22, 2011 EF Tornado found at http://www.abundantlifejoplin.org/images/pdf/facts.pdf

For a listing of Missouri tornadoes that resulted in federal disaster declarations since 1975, see Table A-3 in Section VII.

Figure A-4 shows that tornadoes in Missouri occur most frequently between April and June, with April and May usually producing the most tornadoes. However, tornadoes can occur any time of the year, such as the storms that struck in St. Charles and Barry Counties in November 1988 and Lawrence County in December 2002.

Figure A-4
MISSOURI TORNADOES
Average Per Month 1950 – 2011
January – 1
February – 1
March – 3
April – 6
May – 8
June – 5
July – 2
August – 1
September – 2
October – 1
November – 1
December – 2

IV. MEASURE OF PROBABILITY AND SEVERITY

The United States has 10 times more tornadoes than any other nation in the world. Missouri averages 32 tornadoes per year, and has recorded 2041 tornadoes from 1950 through 2012. Missourians have a high probability that tornadoes will continue to affect their lives. The natural phenomena that create tornadoes will continue to occur beyond our ability to control them.

The enormous power and destructive capability of tornadoes are beyond mankind's capabilities to control. The potential severity of effects from tornadoes will continue to be high. We will continue to experience deaths, injuries, and property damages from tornadoes. However, technological advances will facilitate earlier warnings than previously available. This, combined with a vigorous public education program and improved construction techniques, provides the potential for significant reductions in the number of deaths and injuries, as well as reduced property damage.

V. IMPACT OF THE HAZARD

Every tornado is a potential killer, and many are capable of great destruction. Tornadoes can destroy buildings, roll mobile homes, uproot trees, hurl people and animals through the air for hundreds of yards, and fill the air with lethal, windblown debris. Sticks, glass, roofing material, and lawn furniture all become deadly missiles when driven by tornado winds. In 1975, a Mississippi tornado carried a home freezer for more than a mile. Once, a tornado in Broken Bow, Oklahoma, carried a motel sign 30 miles and dropped it in Arkansas. Tornadoes do their destructive work through the combined action of their strong rotary winds and the impact of windblown debris. In the most simple case, the force of the tornado's winds push the windward wall of a building inward. The wind then pushes the roof up, and the other walls fall outward. Until recently, this damage pattern led to the incorrect belief that the structure had exploded as a result of the atmospheric pressure drop associated with the tornado.

VI. SYNOPSIS

Tornadoes are associated with severe thunderstorms, which by themselves, possess destructive potential. Such storms most often occur in the spring and summer, during the afternoon and evenings, but can occur at any time. In addition to tornadoes, other hazards associated with thunderstorms include the following:

- Damaging winds
- Lightning and resulting fires
- Hail
- Heavy rains causing flash flooding.

The damaging straight-line winds of thunderstorms can exceed 100 mph. Some thunderstorms produce downbursts which is a sudden outrush of damaging wind. Microbursts, are smaller scale events that have a damage area of less than 2.5 miles wide. A Macroburst, is a larger event in which the damage area is larger than 2.5 miles wide. Downbursts can produce strong wind shear (a rapid change in the speed and or direction of wind over a short distance) near the surface. These are especially dangerous to aviation.

In May 1996, a Memorial Day weekend storm identified by the National Weather Service as a microburst caused more than $10 million in damage to homes in Lee's Summit, Missouri. The storm destroyed at least 13 homes and damaged more than 100 others in several Lee's Summit subdivisions. The city also incurred a substantial cost for debris removal and cleanup activities resulting from this devastating storm.

Large hail can reach the size of grapefruit. Hail causes several hundred millions of dollars in damage annually to property and crops across the nation. In addition, over the last 30 years, lightning has killed an average of 55 people each year. During the period of 1959 through 2010, 97 people died in Missouri as a result of lightning strikes.

The thunderstorms associated with tornado development also contribute to the number one weather killer–flash floods. Flash flooding causes an average of 92 deaths annually throughout the nation. During the period from 1992 through 2010, flooding and flash floods claimed the lives of 86 Missourians. Thunderstorm winds claimed 15 lives over this same period.

VII. MAPS OR OTHER ATTACHMENTS

888The following charts and maps depict additional Missouri tornado information, generally for the period between 1950 and 2000:

- Disaster Declarations For Missouri Tornadoes Since 1975: Table A-3
- Missouri Severe Weather Statistics, 2007-2012: Table A-4
- Missouri Tornadoes by County, 1950-2012: Figure A-5
- Missouri Tornado Deaths by County, 1950-2012: Figure A-6
- Disaster Declarations for Spring 2002 Tornadoes DR-1412: Figure A-7

- Disaster Declarations for Spring 2003 Tornadoes DR-1463: Figure A-8
- Disaster Declarations for May 2004 Tornadoes DR-1524: Figure A-9
- Disaster Declarations for March 2006 DR-1631: Figure A-10
- Disaster Declarations for March-April 2006 DR-1635: Figure A-11
- Emergency Declaration for July 2006 EM-3267: Figure A-12
- Disaster Declaration for July 2006 DR-1667: Figure A-13
- Disaster Declarations for May 2008 DR-1760: Figure A-14
- Disaster Declarations for September 2008 DR-1809: Figure A-15
- Disaster Declarations for May 2009 DR-1847: Figure A-16
- Disaster Declarations for June-July 2010 DR-1934: Figure A-17
- Disaster Declarations for April-May 2011 DR-1980: Figure A-18
- Disaster Declarations for Summer 2011 DR-4012: Figure A-19
- SBA Declaration for March 2012: Figure A-20
- Disaster Declaration for June 2013 DR-4130: Figure A-21
- Disaster Declaration for August 2013 DR-4144: Figure A-22

TABLE A-3

DISASTER DECLARATIONS FOR TORNADOES/SEVERE STORMS SINCE 1975

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
May 3, 1975 DR-466	Tornadoes, High Winds, Hail	Caldwell, Newton, Macon, Shelby	IA & PA
May 7, 1977 DR-535	Tornadoes, Flooding	Carroll, Clay, Lafayette, Ray, Cass, Jackson, Pettis	IA & PA
April 21, 1979 DR-579	Tornadoes, Torrential Rain, Flooding	Cape Girardeau, Dunklin, Jefferson, Lincoln, Maries, Mississippi, New Madrid, Pemiscot, Pike, Pulaski, St. Charles, St. Louis City, St. Louis Co, Ste. Genevieve, Scott, Stoddard, & Texas Counties. Cape Girardeau, Dunklin, Jefferson, Lincoln, Maries , Mississippi, New Madrid, Pemiscot, Pike, St. Charles, St. Louis City, St. Louis Co, Ste. Genevieve, Scott, Stoddard, &Texas Counties	IA only PA only
May 15, 1980 DR-620	Severe Storms, Tornadoes	Pettis	IA Only

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
May 1986	Tornadoes	Scott, Mississippi, Cape Girardeau, Perry	SBA Loans
November 1988	Tornadoes	St. Charles, Barry	SBA Loans
November 13-19, 1993 DR-1006	Flooding, Severe Storm, Tornadoes	Bollinger, Butler, Cape Girardeau, Carter, Crawford, Dent, Franklin, Howell, Iron, Jefferson, Madison, Oregon, Perry, Pulaski, Reynolds, Ripley, St. Francois, St. Louis, Ste. Genevieve, Shannon, Stoddard, Texas, Washington, & Wayne Counties. Carter, Dent, Howell, Iron, Madison, Oregon, Perry, Reynolds, St. Fancois, Ste. Genevieve, Shannon, Texas, Washington, & Wayne Counties	IA PA
April 9-May 5, 1994 DR-1023	Severe Storm, Flooding, Tornadoes	Barry, Callaway, Clay, Cole, Franklin, Jefferson, Lincoln, Morgan, Pemiscot, Phelps, Pulaski, Reynolds, St. Charles, St. Louis City, St. Louis Co., Shannon, Vernon, Washington	IA Only
May 13-June 23, 1995 DR-1054	Severe Storm, Tornadoes, Hail, Flooding	Adair, Andrew, Atchison, Barry, Barton, Bates, Benton, Boone, Callaway, Camden, Cape Girardeau, Carroll, Cass, Chariton, Clark, Cole, Cooper, Dallas, Daviess, DeKalb, Franklin, Gasconade, Gentry, Henry, Howard, Jackson, Jasper, Jefferson, Johnson, Lafayette, Lewis, Lincoln, Linn, Macon, Maries, McDonald, Mercer, Miller, Mississippi, Moniteau, Montgomery, Morgan, New Madrid, Newton, Nodaway, Osage, Pemiscot, Perry, Ray, St. Charles, St. Clair, St. Francois, St. Louis City, St. Louis Co, Ste. Genevieve, Saline, Scotland, Scott, Stone, Sullivan, Vernon, & Warren Counties Andrew, Atchison, Barry, Bates, Benton, Boone, Callaway, Cape Girardeau, Carroll, Chariton, Clark, Cole, Cooper, Daviess, DeKalb, Franklin Gasconade, Gentry, Henry, Howard, Jefferson, Johnson, Lafayette, Linn, Macon, McDonald, Mercer, Miller, Mississippi, Moniteau, Montgomery, Nodaway, Perry, Ray, St. Charles, St. Clair, St. Louis, Ste. Genevieve, Saline, Stone, Sullivan, Vernon, & Warren Counties	IA PA
July 1995	Tornadoes	Randolph, (City of Moberly)	SBA Loans

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
May 6, 2002 DR-1412	Tornadoes, Severe Storms, Flooding	Barry, Barton, Bollinger, Butler, Camden, Cape Girardeau, Carter, Cedar, Christian, Crawford, Dade, Dallas, Dent, Douglas, Dunklin, Greene, Hickory, Howell, Iron, Jasper, Jefferson, Laclede, Lawrence, Madison, McDonald, Mississippi, New Madrid, Newton, Oregon, Ozark, Pemiscot, Perry, Polk, Reynolds, Ripley, St. Francois, Ste. Genevieve, Scott, Shannon, Stoddard, Stone, Taney, Texas, Vernon, Washington, Wayne, Webster, & Wright Counties Adair, Barry, Barton, Bollinger, Boone, Butler, Camden, Cape Girardeau, Carroll, Carter, Cedar, Chariton, Christian, Clark, Cooper, Crawford, Dade, Dallas, DeKalb, Dent, Douglas, Grundy, Howard, Howell, Iron, Johnson, Knox, Laclede, Lafayette, Lawrence, Lewis, Lincoln, Linn, Livingston, Macon, Madison, Maries, Marion, McDonald, Mercer, Miller, Mississippi, Oregon, Osage, Ozark, Pemiscot, Perry, Phelps, Pike, Polk, Pulaski, Ralls, Ray, Reynolds, Ripley, Ste. Genevieve County, Schuyler County, Scotland, Scott, Shannon, Shelby, Stoddard, Stone, Sullivan, Taney, Texas, Vernon, Wayne, Webster, & Wright Counties	IA PA
May 6, 2003 DR-1463	Tornadoes, Severe Storms, Flooding	Audrain, Barry, Barton, Bates, Benton, Bollinger, Boone, Buchanan, Callaway, Camden, Cape Girardeau, Cass, Cedar, Chariton, Christian, Clark, Clay, Clinton, Cole, Cooper, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Gasconade, Greene, Henry, Hickory, Howard, Iron, Jackson, Jasper, Jefferson, Johnson, Knox, Laclede, Lafayette, Lawrence, Lewis, Lincoln, Marion, McDonald, Miller, Moniteau, Monroe, Montgomery, Morgan, Newton, Osage, Perry, Pettis, Phelps, Pike, Platte, Polk, Pulaski, Ralls, Randolph, Ray, St. Clair, St. Francois, St. Louis, Ste. Genevieve, Saline, Scott, Shelby, Stoddard, Stone, Taney, Vernon, Washington, & Webster Counties. Barton, Bollinger, Camden, Cedar, Christian, Clay, Crawford, Dallas, Franklin, Gasconade, Greene, Howard, Jasper, Knox, Lawrence, Lewis, Maries, Marion, Miller, Monroe, Oregon, Osage, Platte, Polk, Pulaski, Saline,& Washington Counties	IA PA
June 10, 2004 DR-1524	Tornadoes, Severe Storms, Flooding	Adair, Andrew, Bates, Benton, Buchanan, Caldwell, Carroll, Cass, Cedar, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Henry, Hickory, Jackson, Johnson, Knox, Linn, Livingston, Macon, Mercer, Monroe, Nodaway, Platte, Polk, Randolph, Ray, Shelby, St. Clair, Sullivan, Vernon, and Worth	IA Only

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
March 16, 2006 DR-1631	Tornadoes, Severe Storms, and Flooding	Bates, Benton, Boone, Carroll, Cass, Cedar, Christian, Cooper, Crawford, Greene, Henry, Hickory, Howard, Iron, Jefferson, Johnson, Lawrence, Lincoln, Mississippi, Monroe, Montgomery, Morgan, New Madrid, Newton, Perry, Pettis, Phelps, Putnam, Randolph, St. Clair, Ste. Genevieve, Saline, Scott, Taney, Vernon, Webster, & Wright Counties Bates, Benton, Bollinger, Boone, Carroll, Cedar, Christian, Daviess, Greene, Henry, Hickory, Howard, Iron, Jefferson, Lawrence, Monroe, Montgomery, Morgan, Perry, Pettis, Putnam, Randolph, Ray, St. Clair, Saline, Vernon, Washington, Webster, &Wright Counties	IA PA
April 5, 2006 DR-1635	Tornadoes, Severe Storms	Andrew, Butler, Dunklin, Pemiscot, Pettis, St. Francois & Stoddard Counties Pemiscot County, and Saint Francois County.	IA PA
July 21, 2006EM-3267	Tornadoes, Severe Storms	St. Louis County, St. Louis City, Dent, Iron, Jefferson, Oregon, St. Charles, Washington	PA
July 19-21, 2006 DR-1667	Missouri Severe Storm	City of St. Louis	PA Only
May 5 – 18, 2007 DR-1708	Severe Storms/Flooding	REFER TO ANNEX B CHART & MAPS	
August 19 – 21, 2007 DR-1728	Severe Storms/Flooding	REFER TO ANNEX B CHART & MAPS	
January 7 – 10, 2008 DR-1742	Severe Storms Tornadoes, and Flooding	Newton, McDonald, Barry, Stone, Webster, Dallas, Laclede, Phelps, Maries	PA Only
March 17 – May 30, 2008 DR-1749	Severe Storms and Flooding	REFER TO ANNEX B CHART & MAPS	
May 10-11, 2008 DR-1760	Severe Storms and Tornadoes	Jasper, Newton & Barry Counties	IA
Jun 1 – Sept. 30, 2008 DR-1773	Severe Storms and Flooding	REFER TO ANNEX B CHART & MAPS	

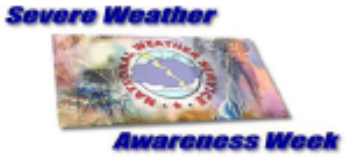
DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
September 11-24, 2008 DR-1809	Severe Storms, Flooding and Tornadoes	Boone, Callaway, Chariton, Howell, Jefferson, Lewis, Lincoln, Linn, Marion, Montgomery, Osage, St. Charles, St. Louis City, St. Louis Co, Schuyler, Stone, Taney, Texas, & Webster Counties Adair, Audrain, Barry, Bollinger, Butler, Callaway, Cape Girardeau, Carter, Chariton, Christian, Clark, Crawford, Dent, Douglas, Dunklin, Howard, Howell, Knox, Lewis, Lincoln, Linn, Madison, Maries, Marion, Miller, Mississippi, New Madrid, Oregon, Ozark, Perry, Ralls, Randolph, Ray, Reynolds, Ripley, Ste. Genevieve, Schuyler, Scotland, Scott, Shannon, Shelby, Stoddard, Stone, Sullivan, Taney, Texas, Wayne, Webster, & Wright Counties	IA PA
May 8 – 16, 2009 DR-1847	Severe Storms, Tornadoes, and Flooding	Adair, Barry, Barton, Bollinger, Cape Girardeau, Christian, Dade, Dallas, Dent, Douglas, Greene, Howell, Iron, Jasper, Jefferson, Laclede, Lawrence, Madison, Newton, Ozark, Polk, Reynolds Ripley, St. Francois, Shannon, Texas, Washington, &Webster Counties. Adair, Barton, Bollinger, Camden, Cape Girardeau, Cedar, Crawford, Dade, Dallas, Dent, Douglas, Greene, Grundy, Hickory, Howell, Iron, Jasper, Knox, Laclede, Lewis, Livingston, Madison, Maries, Marion, Miller, Newton, Oregon, Ozark, Perry, Phelps, Polk, Pulaski, Ray, Reynolds, Ripley, St. Francois, Ste. Genevieve, Saline, Shannon, Shelby, Stone, Sullivan, Texas, Vernon, Washington, Wayne, Webster, & Wright Counties.	IA PA
June 12-July 31, 2010 Dr-1934	Severe Storms, Flooding and Tornadoes	Adair, Andrew, Atchison, Buchanan, Caldwell, Carroll, Cass, Chariton, Clark, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Holt, Howard, Jackson, Knox, Lafayette, Lewis, Linn, Livingston, Marion, Mercer, Monroe, Nodaway, Perry, Pike, Putnam, Ralls, Ray, Schuyler, Scotland, Shelby, Sullivan, & Worth Counties	PA &SBA
April 19-June 6, 2011 DR-1980	Severe Storms, Tornadoes, Flooding	Bollinger, Butler, Cape Girardeau, Carter, Dunklin, Howell, Jasper, Lawrence, McDonald, Mississippi, New Madrid, Newton, Pemiscot, Pettis, Phelps, Pulaski, Reynolds, Ripley, St. Francois, St. Louis, Scott, Stoddard, Stone, Taney, & Wayne Counties Barry, Bollinger, Butler, Cape Girardeau, Carter, Christian, Douglas, Dunklin, Howell, Iron, Jasper, Madison, McDonald, Miller, Mississippi, New Madrid, Newton, Oregon, Ozark, Pemiscot, Perry, Pettis, Polk, Reynolds, Ripley, St. Francois, St. Louis, Ste. Genevieve, Scott, Shannon, Stoddard, Stone, Taney, Texas, Washington, Wayne, Webster, & Wright Counties	IA PA
June 1 – August 1, 2011 DR4012	Severe Storms and Flooding	Andrew, Atchison, Buchanan, Carroll, Cooper, Holt, Howard, Lafayette, Platte, Ray, and Saline counties	IA PA

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
SBA Declaration -February 29 – May 30, 2012	Severe Storms and Tornadoes	Primary counties – Dallas, Stone and Taney Contiguous counties – Barry, Camden, Christian, Douglas, Greene, Hickory, Lawrence, Laclede, Ozark, Polk, Webster	SBA Only
May 29 – June 10, 2013 DR-4130	Severe Storms, Straight-line Winds, Tornadoes, and Flooding	Primary Counties: Barton, Callaway, Cape Girardeau, Chariton, Clark, Howard, Iron, Knox, Lewis, Lincoln, Maries, Marion, Miller, Montgomery, Osage, Perry, Pike, Putnam, Ralls, Scotland, Shelby, St. Charles, St. Louis, Ste. Genevieve, Stoddard, Sullivan, Texas and Webster	PA and SBA Loans
Aug 2-14, 2013 DR-4144	Severe Storms, Straight-line Winds, and Flooding	Primary Counties: Barry, Camden, Cedar, Dade, Dallas, Laclede, Maries, McDonald, Miller, Osage, Ozark, Phelps, Pulaski, Shannon, Taney, Texas, Webster and Wright	PA and SBA Loans

Notes:

IA Individual Assistance
PA Public Assistance
SBA Small Business Administration

TABLE A-4



Missouri Severe Weather Statistics

Tornadoes						
	2012	2011	2010	2009	2008	2007
Total	29	80	64	45	93	42
Deaths	6	158	5	3	19	3
Injuries	70	1182	19	11	232	3
Flash Flood/Flood						
Deaths	0	3	3	2	9	2
Injuries	0	0	0	0	0	4
Lightning						
Deaths	0	3	1	2	0	2
Injuries	0	6	7	1	17	5
Thunderstorm						
Deaths	2	0	0	2	0	0
Injuries	101	9	7	8	22	2
Combined						
Deaths	8	164	9	9	28	7
Injuries	171	1195	33	21	271	14

The 102 tornadoes in Missouri in 2006 is the yearly record.

Missouri Tornadoes (1950 - 2012)

Total: 2041

Yearly Average: 32

Deaths: 394

Yearly Average: 6

FIGURE A-5

Missouri Tornadoes by County 1950 – 2012

Adair	9	Hickory	13	Pulaski	16
Andrew	25	Holt	8	Putnam	9
Atchison	16	Howard	7	Ralls	9
Audrain	19	Howell	38	Randolph	8
Barry	31	Iron	11	Ray	27
Barton	29	Jackson	30	Reynolds	10
Bates	22	Jasper	41	Ripley	18
Benton	22	Jefferson	27	St. Charles	32
Bollinger	18	Johnson	31	St. Clair	18
Boone	31	Knox	8	St. Francois	17
Buchanan	19	Laclede	18	St. Louis	35
Butler	30	Lafayette	23	Ste. Genevieve	7
Caldwell	8	Lawrence	17	Saline	21
Callaway	31	Lewis	12	Schuyler	8
Camden	22	Lincoln	18	Scotland	10
Cape Girardeau	33	Linn	13	Scott	39
Carroll	16	Livingston	11	Shannon	14
Carter	15	McDonald	17	Shelby	18
Cass	34	Macon	17	Stoddard	31
Cedar	17	Madison	18	Stone	21
Chariton	14	Maries	8	Sullivan	11
Christian	27	Marion	12	Taney	12
Clark	14	Mercer	12	Texas	27
Clay	32	Miller	29	Vernon	24
Clinton	19	Mississippi	22	Warren	9
Cole	9	Moniteau	21	Washington	17
Cooper	17	Monroe	19	Wayne	19
Crawford	16	Montgomery	13	Webster	28
Dade	17	Morgan	22	Worth	12
Dallas	13	New Madrid	24	Wright	17
Daviess	17	Newton	40	St. Louis City	5
De Kalb	18	Nodaway	32		
Dent	14	Oregon	17		
Douglas	23	Osage	9		
Dunklin	31	Ozark	32		
Franklin	24	Pemiscot	34		
Gasconade	7	Perry	21		
Gentry	18	Pettis	32		
Greene	39	Phelps	25		
Grundy	10	Pike	16		
Harrison	23	Platte	16		
Henry	10	Polk	25		

FIGURE A-6

Missouri Tornado Deaths by County 1950 - 2012

Adair	2	Hickory	0	Pulaski	0
Andrew	6	Holt	0	Putnam	0
Atchison	0	Howard	0	Ralls	0
Audrain	0	Howell	4	Randolph	4
Barry	4	Iron	0	Ray	2
Barton	2	Jackson	37	Reynolds	0
Bates	0	Jasper	163	Ripley	1
Benton	0	Jefferson	1	St. Charles	0
Bollinger	1	Johnson	1	St. Clair	0
Boone	0	Knox	0	St. Francois	13
Buchanan	0	Laclede	0	St. Louis	15
Butler	1	Lafayette	1	Ste. Genevieve	0
Caldwell	1	Lawrence	8	Saline	0
Callaway	1	Lewis	0	Schuyler	0
Camden	4	Lincoln	0	Scotland	0
Cape Girardeau	1	Linn	0	Scott	8
Carroll	0	Livingston	0	Shannon	4
Carter	8	McDonald	0	Shelby	0
Cass	3	Macon	2	Stoddard	1
Cedar	5	Madison	0	Stone	0
Chariton	0	Maries	0	Sullivan	1
Christian	1	Marion	0	Taney	0
Clark	2	Mercer	0	Texas	2
Clay	0	Miller	0	Vernon	0
Clinton	0	Mississippi	1	Warren	1
Cole	0	Moniteau	0	Washington	6
Cooper	0	Monroe	2	Wayne	0
Crawford	0	Montgomery	0	Webster	2
Dade	0	Morgan	0	Worth	2
Dallas	3	New Madrid	0	Wright	0
Daviess	0	Newton	17	St. Louis City	11
De Kalb	3	Nodaway	0		
Dent	2	Oregon	0		
Douglas	0	Osage	0		
Dunklin	2	Ozark	0		
Franklin	0	Pemiscot	22		
Gasconade	0	Perry	2		
Gentry	0	Pettis	2		
Greene	6	Phelps	2		
Grundy	0	Pike	0		
Harrison	1	Platte	0		
Henry	1	Polk	0		

FIGURE A-7

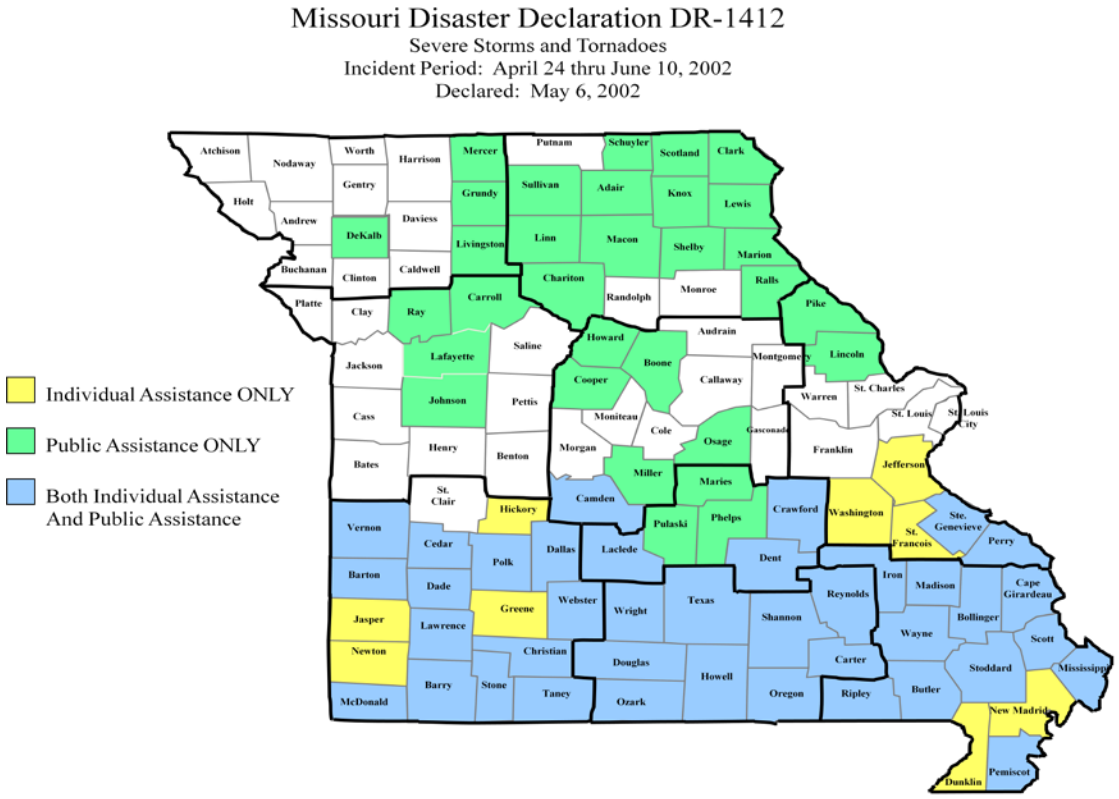


FIGURE A-8

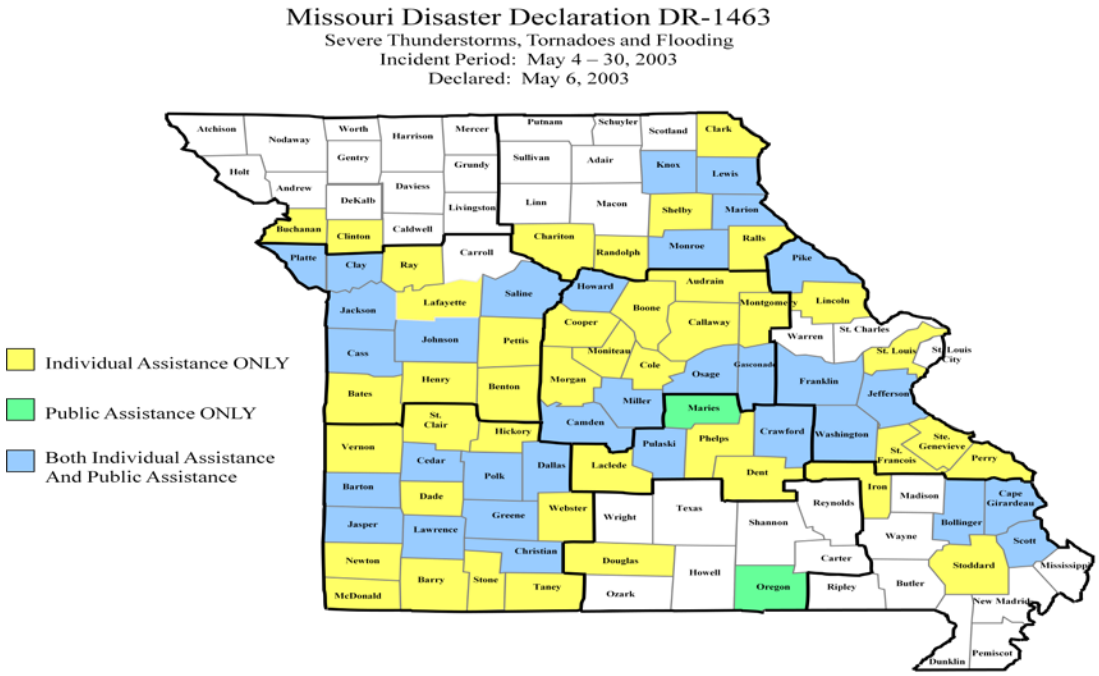


FIGURE A-9

Missouri Disaster Declaration DR-1524
Severe Storms, Tornadoes and Flooding
Incident Period: May 18 – 31, 2004
Declared: June 11, 2004

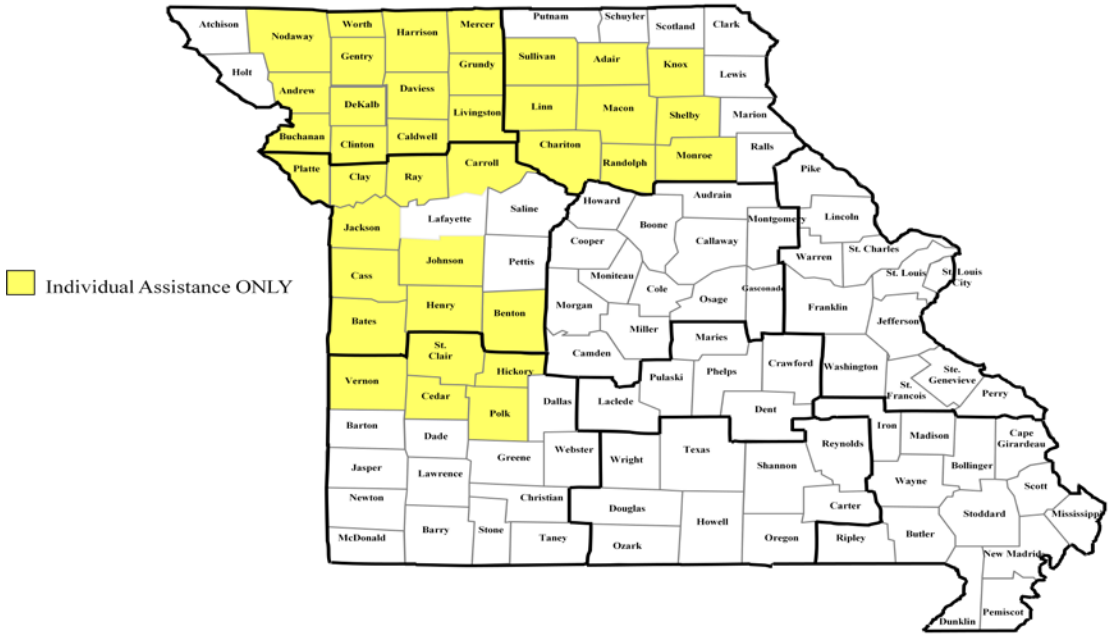


FIGURE A-10

Missouri Disaster Declaration DR-1631
Severe Storms, Tornadoes and Flooding
Incident Period: March 8 – 13, 2006
Declared: March 16, 2006

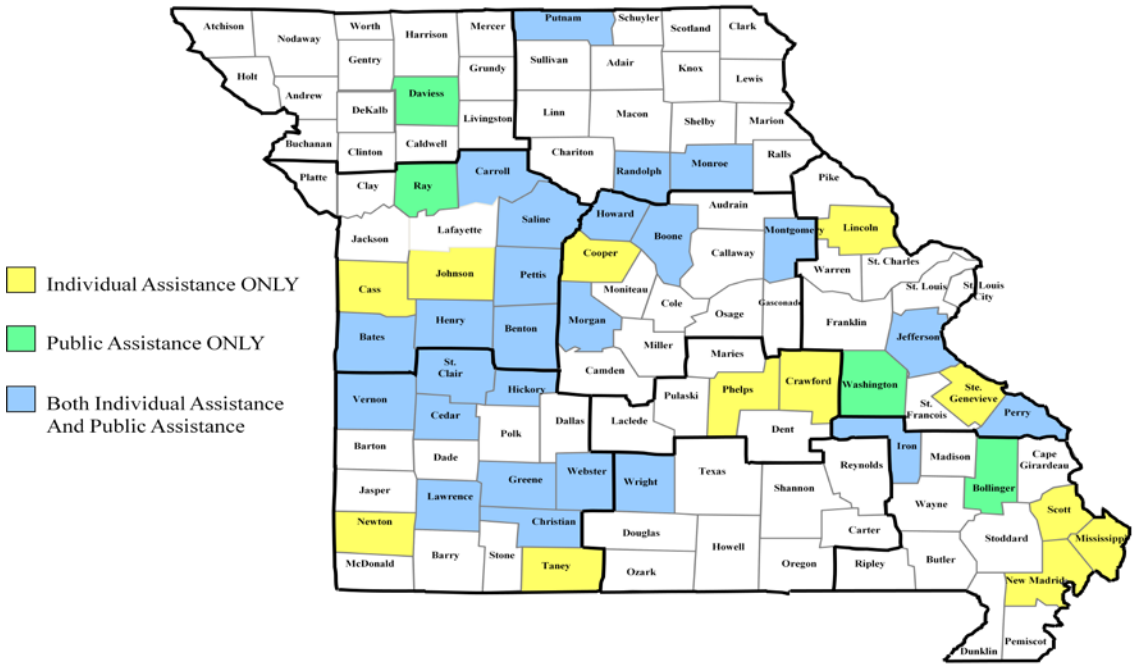


FIGURE A-11

Missouri Disaster Declaration DR-1635
Severe Storms, Tornadoes and Flooding
Incident Period: March 30 thru April 3, 2006
Declared: April 5, 2006

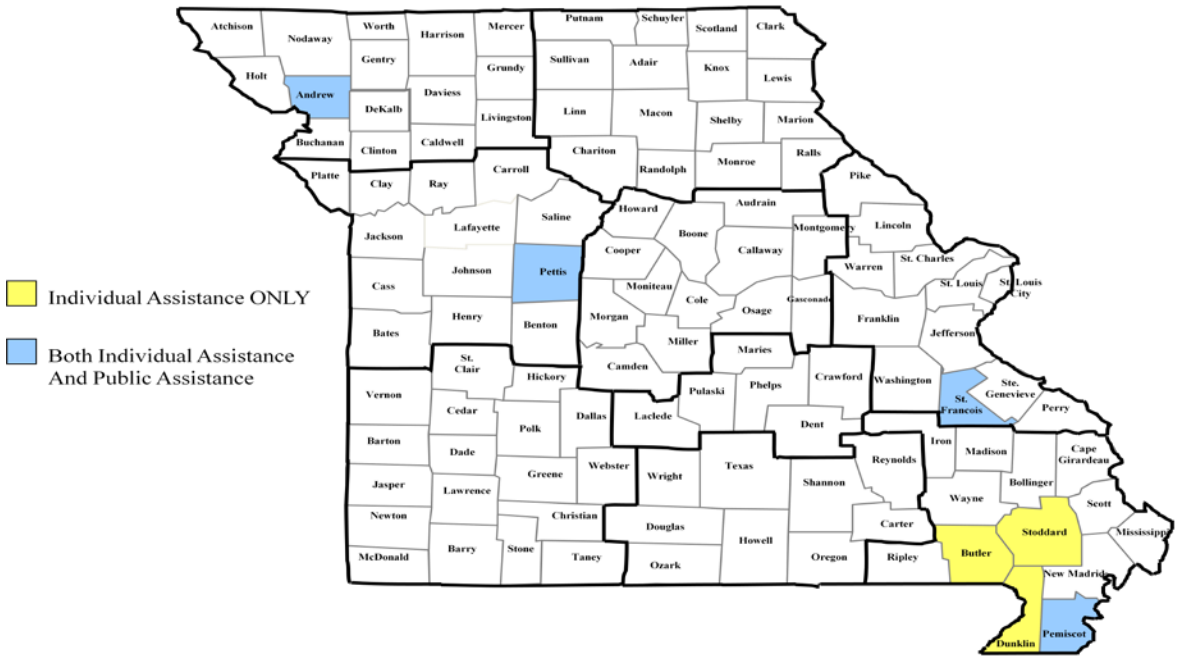


FIGURE A-12

Missouri Disaster Declaration EM-3267
Severe Storms
Incident Period: July 19 - 21, 2006
Declared: July 21, 2006

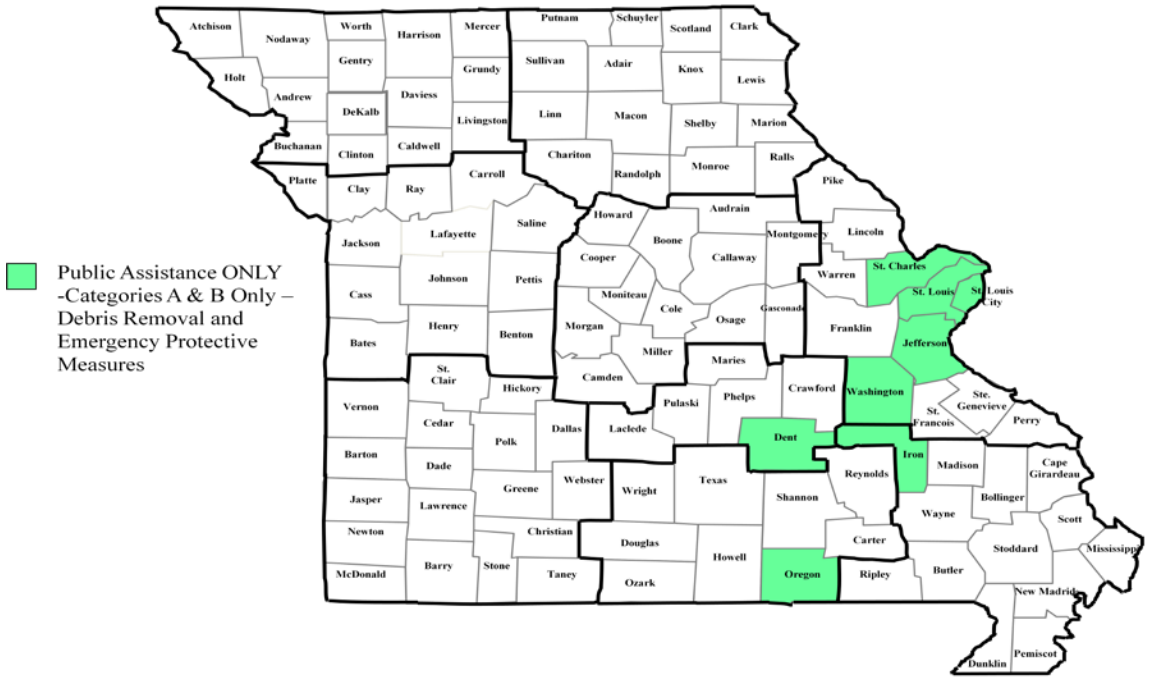


FIGURE A-13

Missouri Disaster Declaration DR-1667
Severe Storms
Incident Period: July 19 – 21, 2006
Declared: November 2, 2006

FIGURE A-14

Missouri Disaster Declaration DR-1760
Severe Storms and Tornadoes
Incident Period: May 10 – 11, 2008
Declared: May 23, 2008

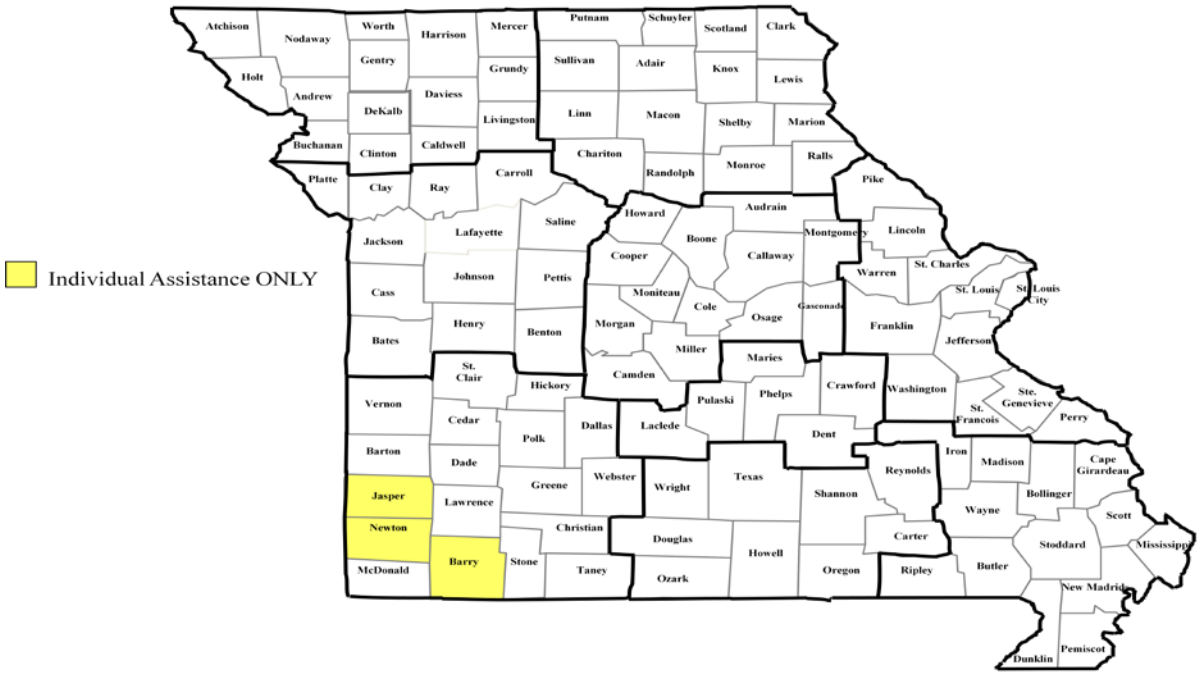


FIGURE A-15

Missouri Disaster Declaration DR-1809
Severe Storms, Flooding and a Tornado
Incident Period: September 11-24, 2008
Declared: November 13, 2008

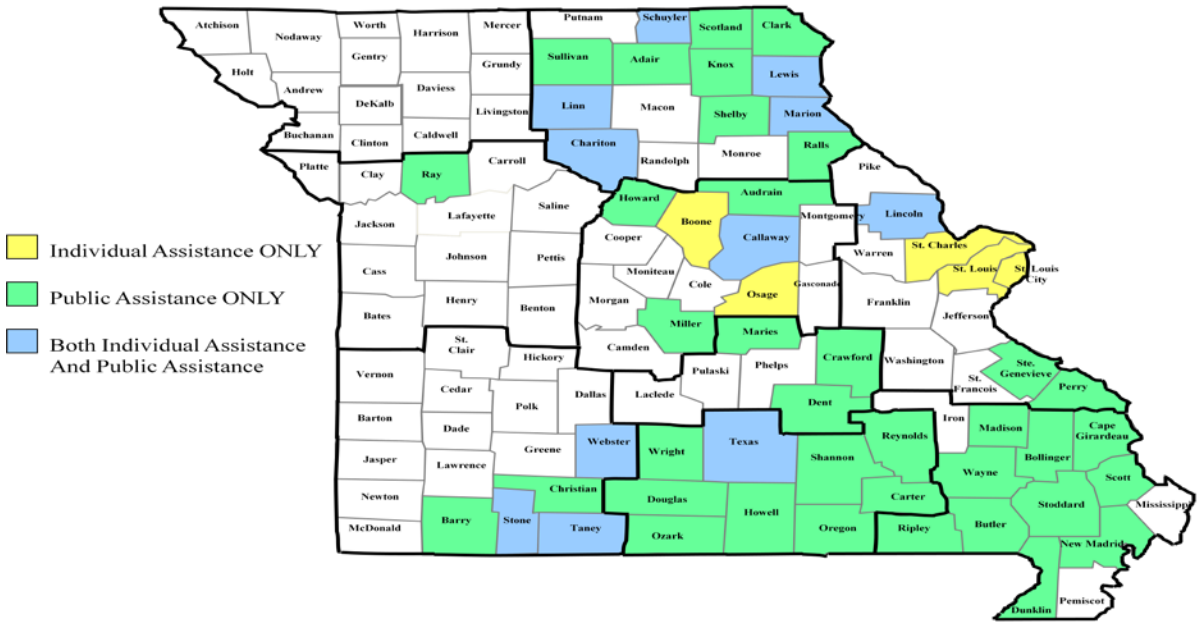


FIGURE A-16

Missouri Disaster Declaration DR-1847
Severe Storms, Tornadoes, and Flooding
Incident Period: May 8 - 16, 2009
Declared: June 19, 2009

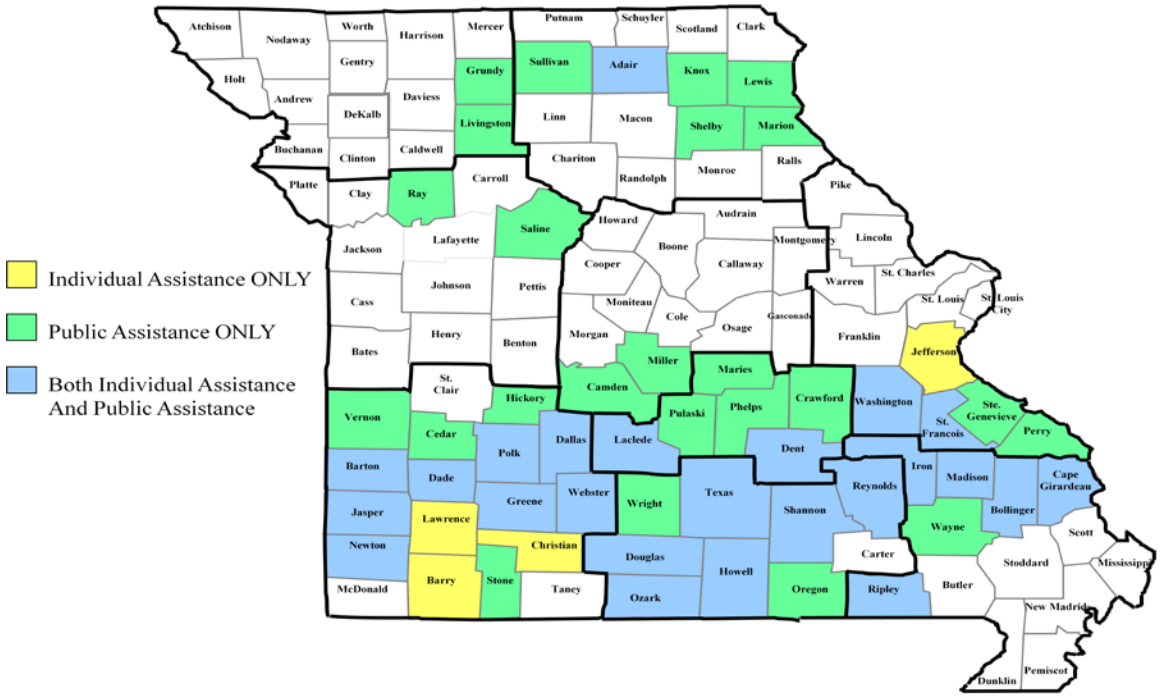


Figure A-17

Missouri Disaster Declaration DR-1934
Severe Storms, Flooding and Tornadoes
Incident Period: June 12 to July 31, 2010
Declared August 17, 2010

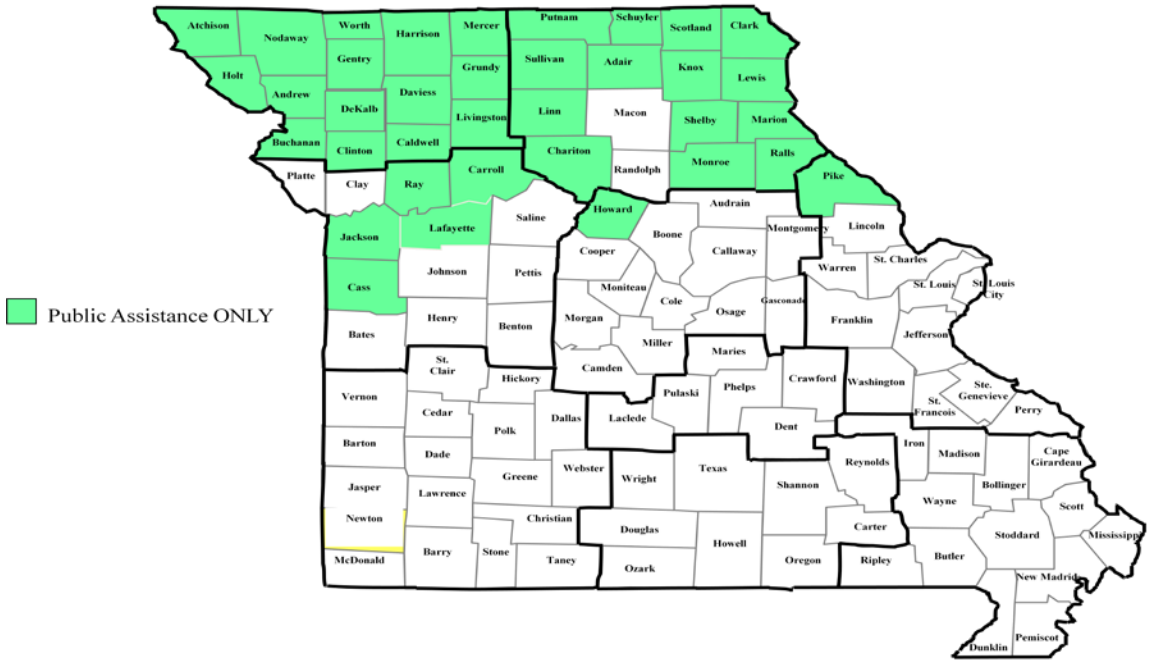
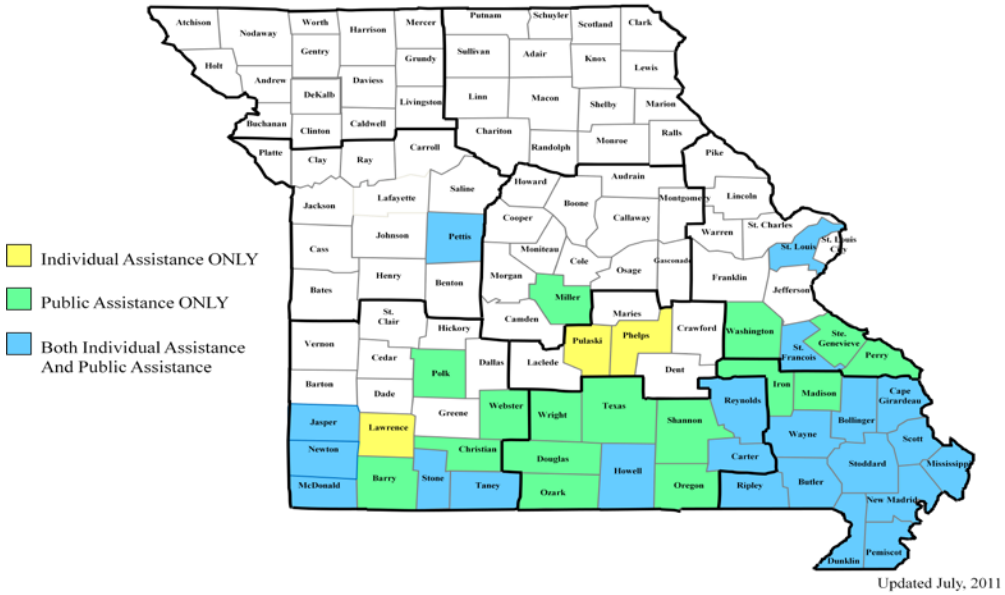


Figure A-18

Missouri Disaster Declaration DR-1980
Severe Storms, Tornadoes, and Flooding
Incident Period: April 19, 2011 and continuing
Declared: May 9, 2011



Updated July, 2011

March 2012
Qualify for Small Business Administration (SBA)
Stand-Alone Declaration

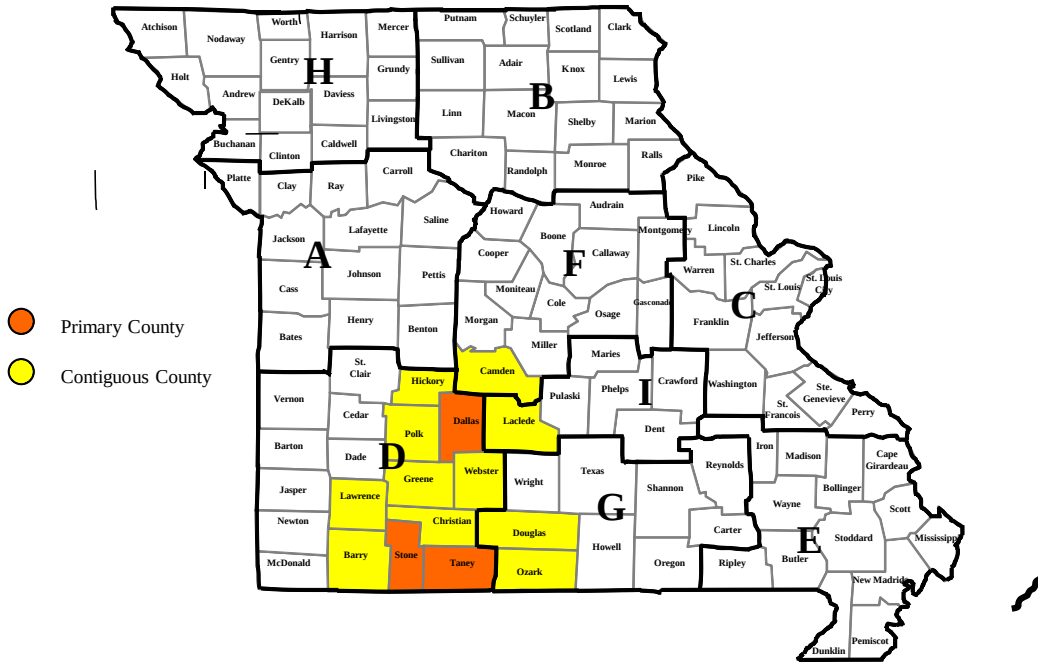


FIGURE A-21

FEMA-4130-DR, Missouri Disaster Declaration as of 08/05/2013

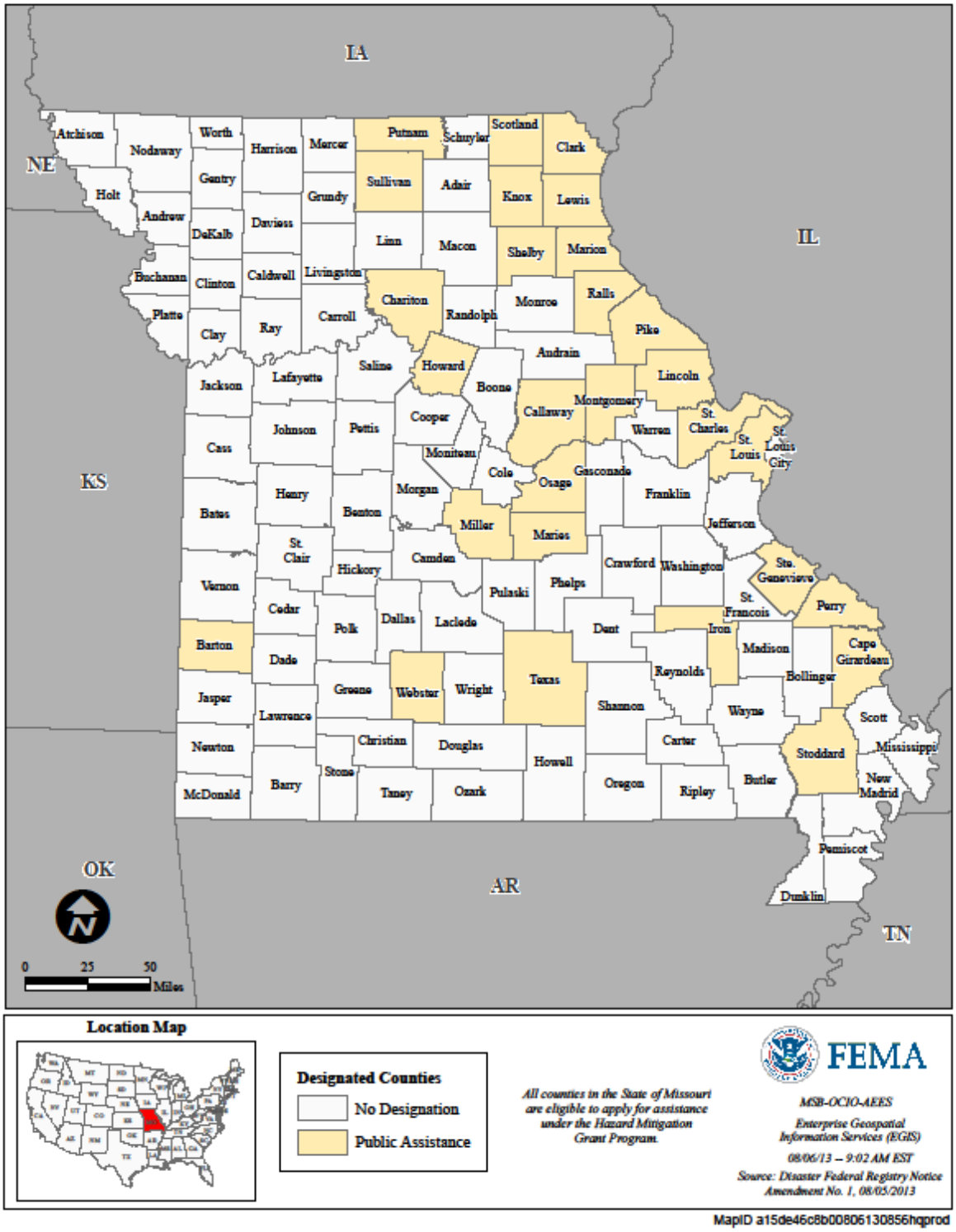
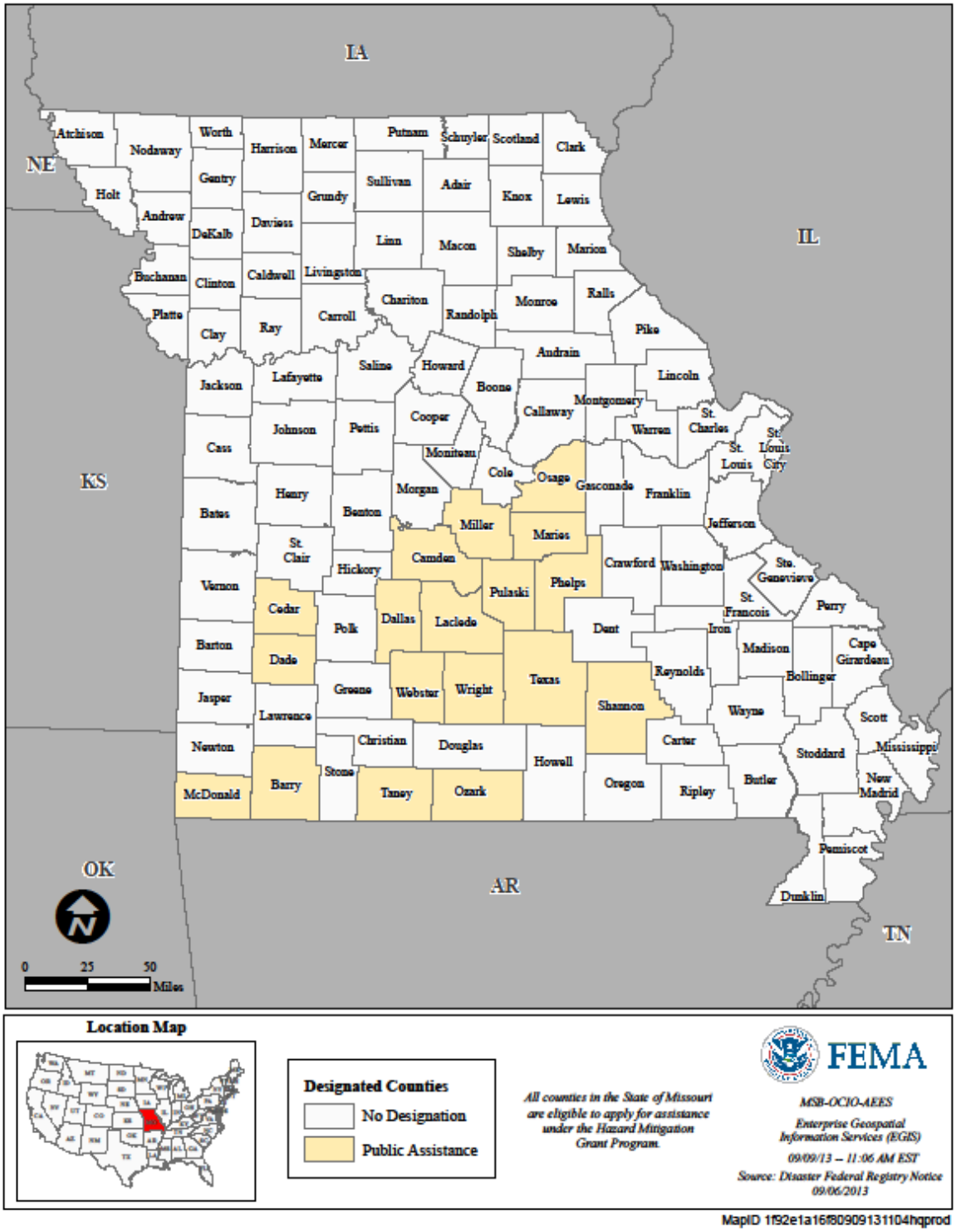


FIGURE A-22

FEMA-4144-DR, Missouri Disaster Declaration as of 09/06/2013



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FEMA Missouri Disaster Declarations Online
http://www.fema.gov/disasters?field_state_tid=67&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=All&items_per_page=10&=GO

ANNEX B

RIVERINE FLOODING
(INCLUDES FLASH FLOODS)

I. TYPE OF HAZARD

Riverine Flooding

II. DESCRIPTION OF HAZARD

Floods are the number one cause of deaths associated with thunderstorms in the United States. Between 1990 and 2012, Missouri recorded more than 97 deaths attributed to flooding. A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Flash flooding is characterized by rapid accumulation or runoff of surface waters from any source. This type of flooding impacts smaller rivers, creeks, and streams and can occur as a result of dams being breached or overtopped. Because flash floods can develop in a matter of hours, most flood-related deaths result from this type of event.

The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100-year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year, based on historical records. Floodplains are a vital part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

The land that forms the State of Missouri is contained within the Mississippi, Missouri, Arkansas, and White River Basins. The Mississippi River Basin drains the eastern part of the state, the Missouri River Basin drains most of the northern and central part of the state, the White River Basin drains the south-central part of the state, and the Arkansas River Basin drains the southwest part of the state. The Missouri River Basin drains over half the state. When the Missouri River joins the Mississippi River at St. Louis, it becomes part of the Mississippi River Basin, which is the largest basin, in terms of volume of water drained, on the North American continent.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations–areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

III. HISTORICAL STATISTICS

Missouri has a long and active history of extensive flooding over the past century. Scores of river communities, such as those along the Mississippi and Missouri Rivers, have become quite skilled and experienced in flood-fighting efforts due to frequent instances of severe flooding in recent years. Flooding along Missouri's major rivers generally results in slow moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, these flood disasters extract a heavy toll in terms of human suffering and extensive losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri.

Ranking among the state's most notable flood disasters are the Missouri River flood of 1927, which spread destruction across 17 million acres, and the flood of 1951, which caused an estimated $400 million in damage. Record flooding also occurred in 1973 along the Mississippi River, where backwater inundated 474,000 acres at a loss of $40 million. The unseasonably heavy rainfall produced severe headwater flooding along many of the area's tributary streams, particularly in the St. John's Basin in Missouri and along the St. Francis and White Rivers in Arkansas. Of special historic interest is the December 1982 flood that spread dioxin-contaminated soil in the Times Beach area near St. Louis and led to a federal buyout of the entire town. In the fall of 1986, record flooding returned in Missouri, as well as in Michigan, Illinois, Kansas, and Oklahoma, with all these states declared federal disaster areas. Significant flooding next occurred in the state in the spring of 1990, particularly along the Missouri River in western, central, and portions of eastern Missouri. Record-level, repetitive flooding occurred from1993 through1995, and flash flooding ravaged several areas of the state in July and October 1998. In the springs of 1999 and 2000, flash flooding and severe storms again battered portions of the state. Between 2001 and 2013, Missouri received 19 major disaster declarations which included some type of flooding.

Note: Counties designated as Disaster Areas in the 1993-1995, 1998, 1999, and 2000 floods are identified on maps in Section VII of this annex.

Floods of 1993-1995

The floods of 1993 through 1995 represent Missouri's worst repetitive flood events. Within this time frame were five Presidential Disaster Declarations, including four in just one 12-month period. This period extended from May 6, 1993, when the first declaration was issued by President Clinton, to April 17, 1994, when the fourth declaration was approved. Flooding in the spring of 1995 resulted in a fifth disaster declaration, issued on June 2, 1995. The ravages of these floods left a legacy of destruction, human suffering, and property damage of unprecedented terms in Missouri history. The fact that Missouri would need several years to recover from these repetitive flood disasters was undisputed. In 1993 alone, a total of 112 of Missouri's 114 counties were included in at least one or more of the declarations. Only Cedar County in southwest Missouri and Dunklin County in the southeast portion of the state were not included in any of the 1993 declarations.

Floods of 1998

Severe flash flooding in the summer and fall of 1998 took a heavy toll in terms of lives lost and extensive property damage in several areas of the state. In all, at least 17 people died as a result of the two flood events. Almost all of the casualties occurred when people attempted to drive their vehicles through rushing water, overturned their vehicle into floodwaters, or were trapped and swept off a flooded bridge.

Both flood incidents ultimately resulted in Presidential Disaster Declarations to provide state and federal assistance in the declared counties.

Spring 1999 and 2000 Floods

On April 3, 1999, a heavy rainstorm in southeast Missouri caused severe flash flooding in Madison County, including the communities of Fredericktown and Marquand. One death (due to electrocution) was attributed to that flood event when 7 to 10 inches of rain fell over a 2-hour period, causing the St. Francois River to crest at twice the height of flood stage. More than 400 homes were adversely affected, with nearly half receiving significant water damage within the living spaces. Seven businesses were damaged, and five were determined to be destroyed. On April 20, 1999, a Presidential Disaster Declaration for individual assistance (MO-DR 1270) was approved for Madison County and five additional counties (Andrew, Cole, Osage, Iron, and Macon) were later approved by FEMA as add-ons to that declaration as a result of subsequent tornadoes and storms. More than 30 Missouri counties were also designated as eligible for disaster relief for agricultural losses suffered from the April storms.

For two consecutive spring seasons, Missouri experienced devastating flash flooding that forced hundreds of people from their homes and caused millions of dollars in property damage to both homes and businesses. Although the flash flooding in both events was confined to few areas, the type of devastation was equal or greater than some of Missouri's worst river flooding events. On May 6 and 7, 2000, a slow-moving storm unleashed 15 inches of rain in Franklin and Jefferson Counties in less than 24 hours. The city of Union in Franklin County was among the hardest hit due to extreme flooding from Flat Creek. In all, 10 counties were included in Presidential Disaster Declaration MO DR 1328, issued on May 12, 2000. Three counties were declared eligible for public assistance and individual assistance, and seven others were declared for individual assistance.

Spring 2003

Flash flooding occurred on May 7th and 8th, and became a major flooding event across all of southern and central Missouri through the early afternoon of May 9th. In addition to the numerous road closures, bridges blocked by debris, evacuations of towns, campgrounds, parks, and moderate river flooding, many communities had their worst flooding in more than 10 years. In Howell County, the most significant damage occurred after the Warm Fork River washed out a portion of train track four miles southeast of West Plains, resulting in a train derailment. Four locomotives, each weighing 260,000 pounds, and 10 railroad cars were knocked off the tracks allowing diesel fuel to flow freely onto the ground. In addition to all of the flash flooding reports, river flooding became significant as all of the southern Missouri rivers rose above flood stage by the middle of May. Some of the rivers crested at levels equivalent to the 1993 flood event.

Flood of 2004

The month of May 2004 saw severe storms containing heavy rains and large hail. A strong storm moved through the state from West to East, roughly along the Interstate 70 corridor during the night of 18 – 19 May. The most severe hit area appeared to be in Cass County South of Kansas City. Twenty-two homes were evacuated in Freeman and Lake Annett in Cass County as a result of major flash flooding.

Spring 2006

A series of severe weather systems pushed across Missouri in March and April. These storms produced a variety of damaging elements which included high winds, tornados, flooding and heavy snow. Forty-nine Missouri counties received Federal Major Disaster Declarations. Through June 14, 2006, homeowners,

renters and business owners who were affected by the severe storms, tornadoes and flooding of March 8-13 and March 30 - April 3, 2006, had been approved to receive more than $32,605,969 million in assistance from the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA), the U.S. Small Business Administration (SBA) and the State of Missouri Emergency Management Agency (SEMA).

Floods of 2007

On January 12-14, a series of severe winter storms swept across Missouri causing heavy damage throughout the state from rain, freezing rain and flooding. An area from Joplin to St. Louis along the I-44 corridor was the heaviest hit. More winter weather came through much of the state on January 20, bringing 4-6" inches of snow in some areas and additional minor ice accumulations. Hundreds of thousands were without power to their homes resulting in 119 shelters being opened across the state.

During the weekend of May 4-7, 2007, a strong upper level storm system generated numerous rounds of heavy rainfall across the Midwest. Even though in the record books the May 2007 floods will not go down as the worst flooding ever experienced in the Midwest, in many locations May 2007 flooding was in the top three events of all time. More significantly, two cities experienced the all-time record flood levels at their locations. The Tarkio River near the city of Fairfax, MO experienced a record high river crest of 25.78 ft recorded Monday, May 7th. This river stage broke the previous record of 25.60 ft set back on July 23, 1993. The second location to experience record flooding was near the city of Napolean, MO. At Napolean, the Missouri River reached a record level of 28.86 ft, eclipsing the previous record of 27.40 ft set back on May 19, 1995.

Heavy rainfall and flash flooding occurred over the Missouri Ozarks and southeast Kansas over the 19th and 20th of August. The heavy rain was a result of the remnant energy from tropical system "Erin" as it interacted with high levels of moisture in the atmosphere. The heaviest rainfall occurred in a band that affected northern Lawrence, Eastern Dade, northern Greene and southern Polk counties where 10 to 12 inches of rainfall occurred. Tropical moisture, high radar reflectivities and slow movement to the storms led to the powerful flash flooding which ripped up roadways, bridges, and caused one death in Laclede County.

Floods of 2008

An unusually early severe weather outbreak hit the Missouri Ozarks Monday afternoon, January 7th, into the early morning hours Tuesday, January 8th, 2008. Numerous supercell thunderstorms spawned at least 33 tornadoes that resulted in significant damage to homes , trees and power lines. The supercell thunderstorms were followed by a violent squall line that produced damaging straight line winds in excess of 70 mph. In addition, the storms produced torrential rainfall and flash flooding. The storms developed as an intense storm system tracked out of the Rockies and interacted with an unseasonably warm, moist and unstable airmass across the Ozarks.

An intensifying wave of low pressure developed on March 17 in the Texas panhandle and headed to the lower Midwest. This system tapped into abundant Gulf moisture and combined with a strong upper level jet and a warm, unstable atmosphere to produce extremely heavy rain from southwestern Missouri eastward into southern Indiana over the next three days. The first area affected was southwestern Missouri, which received most of the heavy rain on March 17 and early on March 18. Much of the region received four to six inches of rain, with isolated areas of 10 inches or more. By the morning of March 18 the surface low pressure system was located near St. Louis, MO, and heavy rain was falling from the central Ozarks into southern Illinois and Indiana. The National Weather Service cooperative observer located in Cape Girardeau, MO reported 13.84 inches for the 48-hour period from the morning of March

18 to the morning of March 20, with the Cape Girardeau Regional Airport reporting 11.49 inches for just the 18th alone. Preliminary measurements indicate that 17.83 inches of rain fell at Cape Girardeau in March 2008. This breaks the previous *all-time* monthly record at Cape Girardeau of 16.89 inches, set in May of 1973, and as well as the March record rainfall of 11.89 inches sent in 1977. Five Missourians died as a result of these storms–two in Greene County, one in Reynolds County, one in Bollinger County and one in Lawrence County. At one point during the event, the Missouri Department of Transportation reported 190 locations on state roads that were closed due to flooding. A few of those locations would remain closed through August as the year of 2008 continued to set record levels of rainfall in Missouri and the Midwest. In all, 17 counties were included in Presidential Disaster Declaration FEMA-1749-DR, for individual assistance issued on March 19, 2008. Another 78 counties were declared eligible for public assistance.

The period February through April 2008 was the wettest on record for the Midwest region, with an average 11.64 inches of precipitation. This was also the wettest February-April for Missouri with 18.92 inches. The wet weather pattern over the southern Midwest in February and March continued into the first half of April. On April 3 and April 4, two to four inches of rain fell from the Missouri Ozarks into western Kentucky, southern Illinois, and southern Indiana, with isolated amounts in excess of 6.50 inches. The heavy rain caused another round of flash flooding and road closures in these areas, and exacerbated flooding already in progress on rivers and streams. On April 8-10 another strong spring storm moved through the Midwest on a more northerly track. This storm dropped another 3 to 4 inches of rain on southwestern Missouri, and one to three inches of rain in a band from northwestern Missouri into southeastern Iowa.

June was a very wet month across a significant portion of the Midwest. Precipitation was more than 200 percent of normal across much of Missouri. The wet first half of the year along with the record June rainfall caused devastating flooding and numerous flash floods in Missouri. This resulted in record flooding on parts of the Mississippi River, even exceeding flood levels reached during the Great Flood of 1993 in some locations. Springfield, MO received 3.88 inches, breaking the old record for the date of 2.00 inches set in 2004. The flash flooding of Galloway Creek in Springfield significantly damaged Galloway Village, a historic section of specialty and antique shops. Water levels reached three feet in just an hour. Flood waters also washed away tons of rock from the railroad line to the James River Power Plant, interrupting coal shipments until workers could finish replacing it several days later. Along the Mississippi, many levees had been standing against water for so long that they were becoming saturated, with structural failure possible even without overtopping. More rain caused already weakened levees to give way. Several cities were wholly or partially flooded by levee failures or overtopping, including Clarksville, Winfield, Foley, and St. Charles. The Winfield case was especially illustrative of the fragility of some levees in the protection system, as the flood waters broke through a 3 inch tunnel dug by a muskrat and poured water out under pressure like a fire house. Many volunteers and National Guard troops were able to keep most of the levees intact. Presidential Disaster Declaration FEMA-1773-DR issued on June 25, 2008 included 27 counties for individual assistance and 72 counties eligible for public assistance.

An early July low pressure developed along the front in the southern Plains and moved along the front, setting off thunderstorms from Missouri through Ohio. Late on July 2 two to six inches of rain fell in western Missouri northwest of Kansas City. The rain caused flash flooding in Parkville, MO. The lower levels of 20 homes were flooded in one subdivision when debris blocked drainage tubes at a bridge. In central Missouri, three to four inches of rain fell in Moniteau, Cole, and Osage counties. The week of July 24th brought extremely heavy rains to previously saturated portions of Missouri. Rainfall exceeded 12 inches in portions of northern Missouri, and amounts from 3 to 6 inches were reported from southern Iowa to just north of St. Louis, resulting in flash flood watches and warnings for much of the region. The largest 24-hour rainfall amount reported was 14.95 inches one mile west of Brunswick, MO. A dam on a

2-acre pond at a country club near Kirksville was breached and water was flooding a major highway. Two men were rescued from a tree after their vehicle was swept off of a road by floodwaters in Ralls County, and authorities reported numerous vehicle rescues. The next round of heavy rain came on July 29-30 as the remnants of Hurricane Dolly entered the Midwest. Heavy rain fell from north of Kansas City, MO across north-central Missouri, preventing any recovery from the flooding caused by the previous two systems. In Platte City, MO, 7.70 inches of rain was recorded into the 24 hour period ending at 7:00 a.m. on July 30, and there were numerous reports of 2 to 3 inches of rain in northwestern Missouri. The heavy rain closed many roads and kept rivers and streams in flood. In the wake of the week of heavy rain in Missouri, Mark Twain Lake, a flood control reservoir and major recreational destination, reached a record level of 640.36 feet on July 30, swelling it to twice its normal size. The previous record was 636.77 feet in 1993. On July 30 the Army Corps of Engineers closed the lake to all boating traffic, and increased the water released through the dam into the Salt River to 50,000 cubic feet per second (cfs). Releases above 12,000 cfs were unprecedented. Authorities also closed the Salt River to recreational boating traffic from the Clarence Cannon Dam to the Mississippi River because of flooding. This had a serious impact on area businesses during the height of the tourist season.

Two tropical systems, Gustav and Ike, brought heavy rain to the central Midwest during the first half of September. Many locations from Missouri through Illinois into southern Michigan received two to three times normal September rainfall, and much of that rain fell the first two weeks of the month. A number of locations set monthly records for precipitation. The heaviest rains were found across the northern half of the state. In northeast Missouri, Kirksville received a total of 8.14 inches of rain, while Columbia measured 7.19 inches of rain from the remnants of Hurricane Ike. The St. Louis area was also hard hit, with O'Fallon reporting 5.84 inches of rain. Three deaths were reported in association with the storm. A woman was killed when a tree was struck by lightning and a limb fell on her in Ladue. Two other people were killed in University City when they were swept away by flood waters while trying to move their vehicles to higher ground. Numerous roads were closed by flooding, including a stretch of Interstate 70. At the peak of the storm nearly 106,000 people were without power in the St. Louis Area.

Spring 2009

A wide swath of severe weather tore across Missouri on May 8th. The fast moving complex of severe thunderstorms brought damaging winds, large hail and tornadoes to southern Missouri and Illinois. Thousands of trees were uprooted, numerous buildings and homes sustained damage from wind and hail. In addition, 3 to locally 5 inches of rainfall caused extensive flash flooding from Crawford County, Missouri to Randolph County, Illinois. Rainfall totals across the southern half of the state reached 200% of normal for the first week of the month. Two weather systems tracked across northern Missouri May 12th through the 16th. The heavy rainfall pushed some locations in the state to rainfall totals exceeding 300% of normal. Flash flood warnings blanketed the affected areas as storms dumped their rain on saturated ground. Roads were closed due to flooding in many rural and urban areas.

Summer 2010

Summertime rainfall was variable across the state from month to month, but overall, statewide average precipitation for June and July totaled 4.59 and 6.59 inches, respectively, and was above normal for both months. Precipitation extremes for June ranged from 8-12 inches across northern Missouri to less than 1-inch over portions of southeastern Missouri. The community of Kahoka, in far northeastern Missouri, reported 14.36 inches for June whereas the town of Bloomfield, in southeastern Missouri, reported no measureable rainfall during the entire month of June. July extremes varied from 7-12 inches over much of central and northeastern Missouri to less than 3 inches in some southeastern communities. Hannibal reported their 2nd wettest July on record with a whopping 17.26 inches. Statewide, the month ranked as the 8th wettest July on record.

Floods of 2011

Heavy April rains across Missouri caused widespread issues with flash flooding. A man drowned in Ozark County after he was washed out of his vehicle while attempting to drive over a low-water crossing. Downpours continued to soak the southern Midwest. Some of the highest totals were in southeast Missouri with totals exceeding 10" including Poplar Bluff which recorded 15.87" of rain. There were 494 daily precipitation records set. Rainfall was in excess of 750% of normal in southeast Missouri. Flood crests continued to work south along the Mississippi River in Missouri and Illinois. Major flooding along the Ohio River and its tributaries had been caused by the heavy rains. As the two rivers come together, communities in Kentucky, Illinois, and Missouri were threatened by record floods potentially higher than 1937 flood crests. On the night of May 2nd the U.S. Army Corps of Engineers blew an 11,000 foot hole in the Bird's Point, MO levee to release water into the New Madrid Floodway and relieve pressure on the flood walls at Cairo, IL. The levee breach flooded more than 130,000 acres of Missouri farmland and required the evacuation of more than 300 homes. At the peak of flooding, 9 shelters were in operation with a population of 160 persons. Eventually, 43 Missouri counties were declared a major disaster.

According to the National Weather Service, almost a year's worth of rain fell over the upper Missouri River basin in the latter half of May. That extremely heavy rainfall in conjunction with an estimated 212 percent of normal snowpack in the Rocky Mountains created an historic amount of water pouring into the Missouri River basin. By the end of June, the U.S. Army Corps of Engineers began releasing waters from the Missouri River Basin Main Stem System at unprecedented levels. This set the stage for long term flooding lasting 3+ months. On June 23rd the Missouri River at Brownville set an all-time high record of 44.79 feet. And on June 27th the Missouri River at Rulo reached a new record level of 27.26 feet. Numerous levees were overtopped, failed, or sustained damage in counties such as Atchison, Andrew, Buchanan, Carroll, Holt and Platte. Entire communities including Big Lake, Bigelow, Corning, Fortescue and Nodaway were evacuated. Other cities and towns began sustained, continual flood fighting operations. Tens of thousands of agricultural lands were inundated by floodwaters.

Floods of 2013

April precipitation was significant across much of the Midwest, with a large portion of the central Midwest receiving at least 6" of precipitation throughout the month. This precipitation was 150% to 300% of normal across much of the region. April was not only a rainy month for much of the region, but a snowy month as well for northern states. The significant April snowfall totals were anywhere from 20" to 35" above normal for that time of year. Moist air surged ahead of a strong cold front and low-pressure system on April 17th and 18th, which brought heavy precipitation and damaging flash floods to Missouri. One area that experienced flash flooding was De Soto Missouri, where an 80 year old woman lost her life after driving into a flooded roadway and her car was swept downstream in Joachim Creek. Mississippi River gages north of St Louis recorded the worst early spring flooding since 1973. The pattern of significant moisture continued into May. Over 15 inches of rain fell near Marshalltown, IA. Precipitation in Missouri averaged above normal for May with a statewide average of 6.97 inches, more than two inches above normal. More than 10-inches of rain were reported in 14 Missouri counties. Eventually, 43 Missouri counties were declared a disaster eligible for public assistance.

Extreme heavy rainfall occurred on an every night basis in differing locations across the Missouri Ozarks and southeast Kansas from August 3rd through August 10th. Rainfall rates of around two inches per hour occurred with these storms each night and trained across the same locations for several hours. High 24 hour precipitation totals were the result with some locations receiving between 8 to 10 inches of rain in a

short window of time. Portions of Pulaski and Wright County received over 15 inches of rain. This extreme amount of rainfall led to dangerous flash flooding, many water rescues, and hundreds of flooded roadways. Three fatalities were reported in two separate incidents involving cars swept away by flash flooding. A mother and son perished in Pulaski County, and another woman was swept away as she tried to cross a flooded creek in McDonald County. Record flood crests were reported along parts of the Gasconade River, including Rich Fountain in Osage County, where on August 8 it was 1.1 feet deeper than the previous record set on December 6, 1982. Eventually, 18 Missouri counties were declared a disaster eligible for public assistance.

IV. MEASURE OF PROBABILITY AND SEVERITY

In terms of overall damage, Missouri's most severe single hazard is flooding. While the state averages some 26 tornadoes each year, damage is generally confined to small areas with few fatalities, if any. By contrast, flooding has resulted in more federal disaster declarations in Missouri than any other hazard in the past five decades. Missouri federal disaster declarations due to flooding account for 69% of all federal disaster declarations received.

Missouri's vulnerability to flooding is greatly increased because it is subject to flooding from two principal sources: the Missouri River Basin and the upper Mississippi River Basin. Over one-third of the annual monetary losses due to flooding in the Missouri River Basin occur within the State of Missouri.

Flash flooding can occur virtually anywhere in the state experiencing an abundance of rainfall in a very short time span, as with the November 1993 flood disaster, and floods of 1998 and 1999. The backing up of tributary stream flows creates flooding problems along the Mississippi River, especially in the southern area of the state where the land tends to be very flat and at low elevations. Even though many flood control projects have been implemented and directly aid in flood prevention, the state is still flood prone due to its geography and location.

The National Weather Service has three response levels for alerting the public as to the danger of floods, as described below:

Response Level	Activity
Flood Watch	Flash flooding or flooding is possible within the designated area.
Flood Warning	Flash flooding or flooding has been reported or is imminent. Necessary precautions should be taken at once.
Flood Advisory	Flooding of small streams, streets, and low-lying areas, such as railroad underpasses and urban storm drains, is occurring.

The threat of flooding is more likely in the spring, when late winter or spring rains, coupled with melting snow, fill river basins with too much water too quickly. Spring also represents the onset of severe weather in the form of thunderstorms, tornadoes, and heavy rains, which can generate flash flooding along these storm fronts. However, as demonstrated by the disaster declarations in December 1982 and the Great Summer Flood of 1993, severe flooding can occur in Missouri at any time of the year. Based on this information, the State rates the probability and severity of floods as high.

V. IMPACT OF THE HAZARD

The Federal Emergency Management Agency estimates that more than 216,000 households are within designated floodplains in Missouri. In addition, thousands of other Missouri residents are at risk to the dangers of flash flooding from rapidly rising creeks and tributaries, storm water runoff, and other similar flooding events. Nationwide, most flood deaths are from flash floods, and nearly half of these fatalities are auto related, according to the National Weather Service.

Of the 49 deaths recorded during the floods of 1993, 35 (71 percent) were from flash floods. In that same category, 20 deaths (77 percent) were related to motor vehicles caught in flash floods. Missouri's river flooding in 1993 claimed 14 lives, with 6 deaths (23 percent) attributed to motor vehicles. (See flood-related mortality charts and maps in Section VII.)

Missouri flood disasters have inflicted tremendous loss in terms of damage to personal property, businesses, infrastructure/public property, and agriculture. Total losses during the 1993 flood disasters were estimated at approximately $3 billion. In addition, agricultural losses were estimated at $1.8 billion, as 3.1 million acres of farmland were either damaged or went unplanted because of the 1993 rains. The Department of Agriculture estimated that 445,000 acres of Missouri River bottomland were destroyed by washouts and sand scouring. While levees designed to protect up to 50-year floods did their jobs, the amount of rain and up-river flooding took their toll. Of the 1,456 public and private levees in the state, approximately 840 were damaged.

Almost every Missourian was at some time affected by the 1993 floods through inundation of roadways, airports, and drinking water and sewage treatment facilities, and by loss of income. The Missouri Department of Labor and Industrial Relations reported that $6.2 million was disbursed for disaster unemployment assistance for people who lost work due to flooding from July 1993 through March 1994.

The floods of 1993-94 pointed out that too many Missourians were living in a floodplain. To rebuild in the floodplains, those whose homes sustained substantial damage (50 percent or more) were required to elevate the structures above the base flood level to protect from future flood damage. Under Missouri's Community Buyout Program, more than $30 million in federal money was committed to moving Missourians voluntarily out of the floodplains through the acquisition of primary residential properties. As a result of those actions, it is estimated that state taxpayers will save more than $200 million in future flood disaster claims.

VI. SYNOPSIS

Flood events are often accompanied by other types of severe weather, including tornadoes, lightning, and severe thunderstorm activity. These storms also present a danger to life and property, often resulting in many injuries, and in some cases, fatalities. Floodwaters themselves often interact with hazardous materials. This has prompted the evacuation of many citizens near such materials stored in large containers that could break loose or puncture as a result of flood activity. Such events occurred during the 1993 flood, when approximately 11,000 St. Louis residents residing near flood-threatened propane tanks were evacuated on July 30. Evacuations were also ordered on July 31, when bulk propane tanks were flooded by the River Des Peres in St. Louis County. Federal and state agencies retrieved more than 247 large storage tanks; 1,178 small tanks; 3,470 large drums (over 15 gallons); and 5,731 small drums that had been swept away by the floods.

Public health concerns that may result from flooding include the need for disease and injury surveillance, community sanitation to evaluate flood-affected food supplies, private water and sewage sanitation, and vector control (for mosquitoes and other entomology concerns).

VII. MAPS OR OTHER ATTACHMENTS

River Basin and Floodplain Maps are on file at the State Emergency Management Agency. The following maps and tables depict additional Missouri flood information, generally from 1993 through Present.

- Record High-Water Stages in Missouri During the Summer 1993 Flood: Table B-1
- Distribution of Levee Failures by Corps of Engineers District Number of Failed or Overtopped Levees, Summer 1993 Flood: Table B-2
- Causes of Death by Type of Flood, Summer/Fall 1993: Table B-3
- Disaster Declarations for Flooding, Flash Floods, and Severe Storms: Table B-4
- Spring 1993 Flood – DR-989: Figure B-1
- Summer-Fall 1993 Flood – DR-995: Figure B-2
- Spring 2007 Flood – DR-1708: Figure B-3
- Summer 2007 Flood – DR-1728: Figure B-4
- Spring 2008 Flood – DR-1749: Figure B-5
- Summer 2008 Flood – DR-1773: Figure B-6
- Flood-Related Mortality, Missouri 1993: Figure B-7.

TABLE B-1

RECORD HIGH-WATER STAGES IN MISSOURI DURING THE SUMMER 1993 FLOOD (IN FEET)

River	1993 Level	Previous Record	Flood Stage
Mississippi River			
Hannibal	31.8	28.6	16
St. Louis	49.4	43.3	30
Cape Girardeau	48.0	45.6	32
Missouri River			
St. Joseph	32.7	26.8	17
Kansas City	48.9	46.2	32
Jefferson City	38.6	34.2	23
Hermann	36.3	35.8	21

St. Charles	39.5	37.5	

Source: U.S. Army Corps of Engineers (1993).

TABLE B-2

DISTRIBUTION OF LEVEE FAILURES BY CORPS OF ENGINEERS DISTRICT NUMBER OF FAILED OR OVERTOPPED LEVEES, SUMMER 1993 FLOOD

Corps of Engineers District	Federal Levees	Non-Federal Levees
St. Louis*	12 of 42	39 of 47
Kansas City**	6 of 48	810 of 810

Source: Natural Disaster Survey Report, "The Great Flood of '93."

Notes: The difference in the failure rates above is because most federal levees are designed to withstand a 100- to 500-year flood, while non-federal levees, predominantly protecting agricultural lands, are frequently designed for a flood with a return period of 50 years or less.

* Includes eastern Missouri and portions of Illinois.
** Includes northwestern, west-central, and portions of southwest Missouri, and areas in Kansas and Nebraska.

For information on specific river and stream gauge levels go to:

- Kansas City/Pleasant Hill: http://water.weather.gov/ahps2/index.php?wfo=eax
- Springfield: http://water.weather.gov/ahps2/index.php?wfo=sgf
- St. Louis: http://water.weather.gov/ahps2/index.php?wfo=lsx

TABLE B-3

SUMMER/FALL 1993
CAUSES OF DEATH BY TYPE OF FLOOD

	River Flood	Flash Flood	Total
Motor Vehicle	6 (23%)	20 (77%)	26 (53%)
Drowning	5 (25%)	14 (74%)	19 (39%)
Electrocution	1 (50%)	1 (50%)	2 (4%)
Cardiac	2 (100%)	0	2 (4%)
All Causes	14 (29%)	35 (71%)	49 (100%)

TABLE B-4

DISASTER DECLARATIONS FOR FLOODING, FLASH FLOODS, AND SEVERE STORMS

April 15-May 29, 1993 DR-989	Severe Storm & flooding	Jefferson, Lincoln, Marion, Pike, Ralls, St. Charles, St. Louis, and Ste. Genevieve Counties	IA Only
June 10-Oct. 25, 1993 DR-995	Flooding, Severe Storms	Adair, Andrew, Atchison, Audrain, Barry, Barton, Bates, Benton, Boone, Buchanan, Caldwell, Callaway, Camden, Cape Girardeau, Carroll, Cass, Chariton, Christian, Clark, Clay, Clinton, Cole, Cooper, Crawford, Dade, Dallas, Daviess, DeKalb, Douglas, Franklin, Gasconade, Gentry, Greene, Grundy, Harrison, Henry, Hickory, Holt, Howard, Howell, Jackson, Jasper, Jefferson, Johnson, Kansas City, Knox, Laclede, Lafayette, Lawrence, Lewis, Lincoln, Linn, Livingston, Macon, Maries, Marion, McDonald, Mercer, Miller, Mississippi, Moniteau, Monroe, Montgomery, Morgan, New Madrid, Newton, Nodaway, Osage, Pemiscot, Perry, Pettis, Phelps, Pike, Platte, Polk, Pulaski, Putnam, Ralls, Randolph, Ray, St. Charles, St. Clair, St. Francois, St. Louis City, St. Louis Co., Ste. Genevieve, Saline, Schuyler, Scotland, Scott, Shelby, Stoddard, Stone, Sullivan, Taney, Texas, Vernon, Warren, Washington, Wayne, Webster, Worth, and Wright Counties. Andrew, Atchison, Barry, Barton, Bates, Benton, Boone, Buchanan, Caldwell, Callaway, Camden, Cape Girardeau, Carroll, Cass, Chariton, Christian, Clark, Clay, Clinton, Cole, Cooper, Crawford, Dade, Dallas, Daviess, DeKalb, Douglas, Franklin, Gasconade, Gentry, Greene, Grundy, Harrison, Henry, Holt, Howard, Jackson, Jefferson, Johnson, Kansas City, Knox, Laclede, Lafayette, Lawrence, Lewis, Lincoln, Linn, Livingston, Macon, Maries, Marion, McDonald, Mercer, Miller, Mississippi, Moniteau, Monroe, Montgomery, Morgan, New Madrid, Newton, Nodaway, Osage, Ozark, Pemiscot, Perry, Pettis, Pike, Platte, Polk, Pulaski, Putnam, Ralls, Ray, St. Charles, St. Clair, St. Louis City, St. Louis Co., Ste. Genevieve, Saline, Schuyler, Scotland, Shelby, Stone, Sullivan, Texas, Warren, Worth, and Wright Counties.	IA PA
November 13-19, 1993 DR-1006	Flooding, Severe Storm, Tornadoes	REFER TO ANNEX A CHART & MAPS	
April 9-May 5, 1994 DR-1023	Severe Storm, Flooding, Tornadoes	REFER TO ANNEX A CHART & MAPS	
May 13-June 23, 1995 DR-1054	Severe Storm, Tornadoes, Hail, Flooding	REFER TO ANNEX A CHART & MAPS	
July 1995	Tornadoes	REFER TO ANNEX A CHART & MAPS	

May 6, 2002 DR-1412	Tornadoes, Severe Storms, Flooding	REFER TO ANNEX A CHART & MAPS	
May 6, 2003 DR-1463	Tornadoes, Severe Storms, Flooding	REFER TO ANNEX A CHART & MAPS	
June 10, 2004 DR-1524	Tornadoes, Severe Storms, Flooding	REFER TO ANNEX A CHART & MAPS	
March 16, 2006 DR-1631	Tornadoes, Severe Storms, and Flooding	REFER TO ANNEX A CHART & MAPS	
April 5, 2006 DR-1635	Tornadoes, Severe Storms	REFER TO ANNEX A CHART & MAPS	
January 12-22, 2007 DR-1676	Severe Winter Storms & Flooding	REFER TO ANNEX C CHART & MAPS	PA Only
May 5 – 18, 2007 DR-1708	Severe Storms/Flooding	Andrew, Atchison, Buchanan, Carroll, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Holt, Jackson, Lafayette, Livingston, Morgan, Nodaway, Osage, &Platte Counties Andrew, Atchison, Bates, Caldwell, Carroll, Cass, Chariton, Clinton, Daviess, Gentry, Grundy, Harrison, Holt, Howard, Lafayette, Linn, Livingston, Mercer, Nodaway, Platte, Ray, Saline, Sullivan, & Worth Counties	IA PA
August 19 – 21, 2007 DR-1728	Severe Storms/Flooding	Dade, Lawrence, Polk, Greene, Dallas, Webster, Laclede	PA Only
January 7 – 10, 2008 DR-1742	Severe Storms Tornadoes, and Flooding	REFER TO ANNEX A CHART & MAPS	
February 10-14, 2008 DR-1748	Severe Winter Storms & Flooding	REFER TO ANNEX C CHART & MAPS	PA Only

March 17 – May 30, 2008 DR-1749	Severe Storms and Flooding	Bollinger, Butler, Callaway, Cape Girardeau, Carter, Christian, Franklin, Gasconade, Greene, Howard, Iron, Jasper, Jefferson , Laclede County, Madison, Maries, McDonald, Newton, Oregon, Osage, Phelps, Pulaski, Reynolds, Ripley, St. Francois, St. Louis, Scott, Shannon, Stoddard, Stone, Taney, Texas, Washington, Wayne, & Webster Counties. Barry, Barton Bollinger, Boone, Butler, Camden, Cape Girardeau, Carter, Cedar, Christian, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Gasconade, Howard, Howell, Iron, Jefferson, Laclede, Lawrence Madison, Maries, McDonald, Miller, Mississippi, Montgomery, New Madrid, Newton, Oregon, Osage, Ozark, Pemiscot, Perry, Phelps, Pulaski, Reynolds, Ripley, St. Clair, Scott, Shannon, Stoddard, Stone, Taney, Texas, Vernon, Washington, Wayne, Webster, & Wright Counties.	IA PA
May 10-11, 2008 DR-1760	Severe Storms and Tornadoes	REFER TO ANNEX A CHART & MAPS	
Jun 1 – Sept. 30, 2008 DR-1773	Severe Storms and Flooding	Adair, Andrew, Callaway, Cass, Chariton, Clark, Gentry, Greene, Harrison, Holt, Johnson, Lewis, Lincoln, Linn, Livingston, Macon, Marion, Monroe, Nodaway, Pike, Putnam, Ralls, St. Charles, Stone, Taney, Vernon, & Webster Counties. Adair, Andrew, Atchison, Audrain, Bates, Callaway, Cape Girardeau, Carroll, Chariton, Christian, Clark, Daviess, Gentry, Grundy, Harrison, Holt, Howard, Knox, Lewis, Lincoln, Linn, Livingston, Macon, Marion, Mercer, Miller, Mississippi, Monroe, Morgan, Nodaway, Perry, Pettis, Pike, Polk, Putnam, Ralls, Randolph, Ray, St. Charles, Ste. Genevieve, Saline, Schuyler, Scotland, Shelby, Stone, Sullivan, Taney, Vernon, Webster, & Worth Counties	IA PA
September 11-24, 2008 DR-1809	Severe Storms, Flooding and Tornadoes	REFER TO ANNEX A CHART & MAPS	
May 8 – 16, 2009 DR-1847	Severe Storms, Tornadoes, and Flooding	REFER TO ANNEX A CHART & MAPS	
June 12-July 31, 2010 Dr-1934	Severe Storms, Flooding and Tornadoes	REFER TO ANNEX A CHART & MAPS	
April 19-June 6, 2011 DR-1980	Severe Storms, Tornadoes, Flooding	REFER TO ANNEX A CHART & MAPS	

May 29, 2013 to June 10, 2013 DR-4130	Severe Storms, Straight-line Winds, Tornadoes, and Flooding	REFER TO ANNEX A CHART & MAPS	
August 2 2013 to August 14 2013 DR-4144	Severe Storms , Straight-line Winds, Tornadoes, and Flooding	REFER TO ANNEX A CHART & MAPS	

Notes:

IA Individual Assistance
PA Public Assistance
SBA Small Business Administration

FIGURE B-1

Missouri Disaster Declaration DR-0989
Severe Storm, Flooding
Incident Period: April 15 thru May 29, 1993
Declared: May 11, 1993

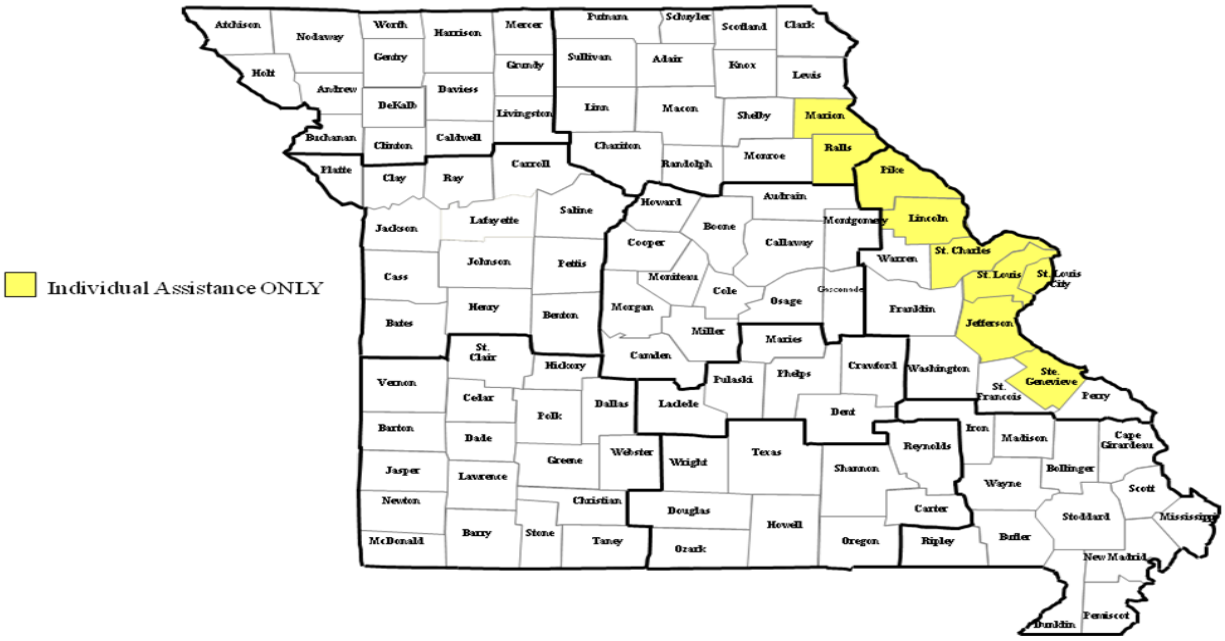


FIGURE B-2

Missouri Disaster Declaration DR-0995
Flooding, Severe Storms
Incident Period: June 10 thru October 25, 1993
Declared: July 9, 1993

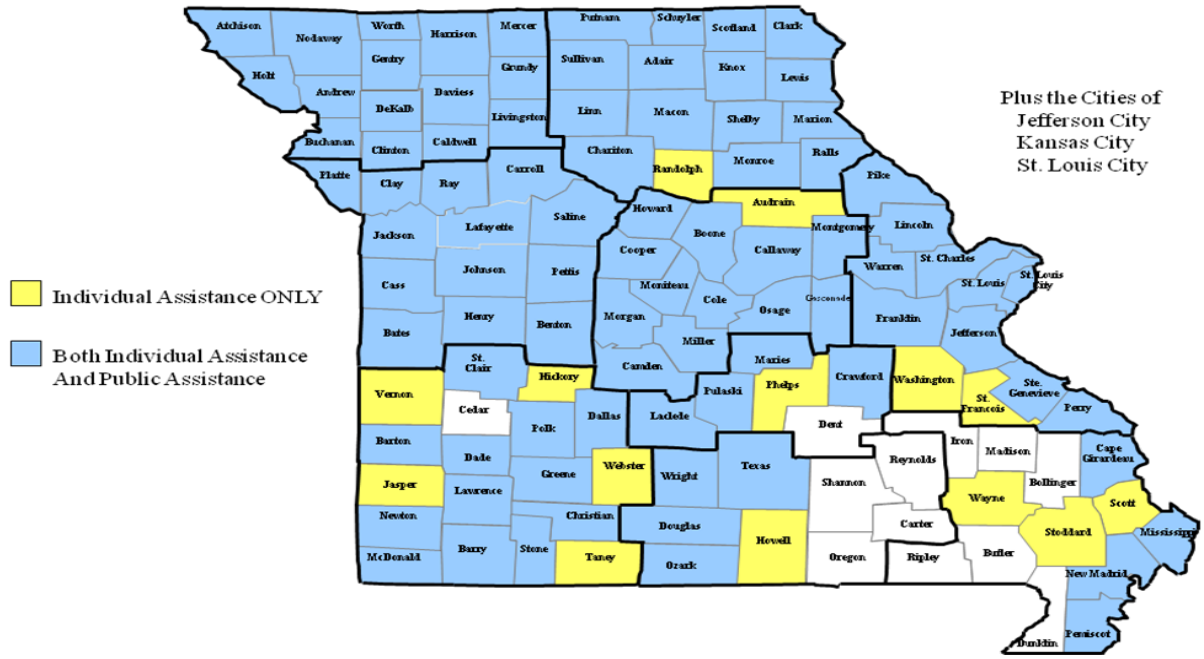


FIGURE B-3

Missouri Disaster Declaration DR-1708
Severe Storms and Flooding
Incident Period: May 5 – 18, 2007
Declared: June 11, 2007

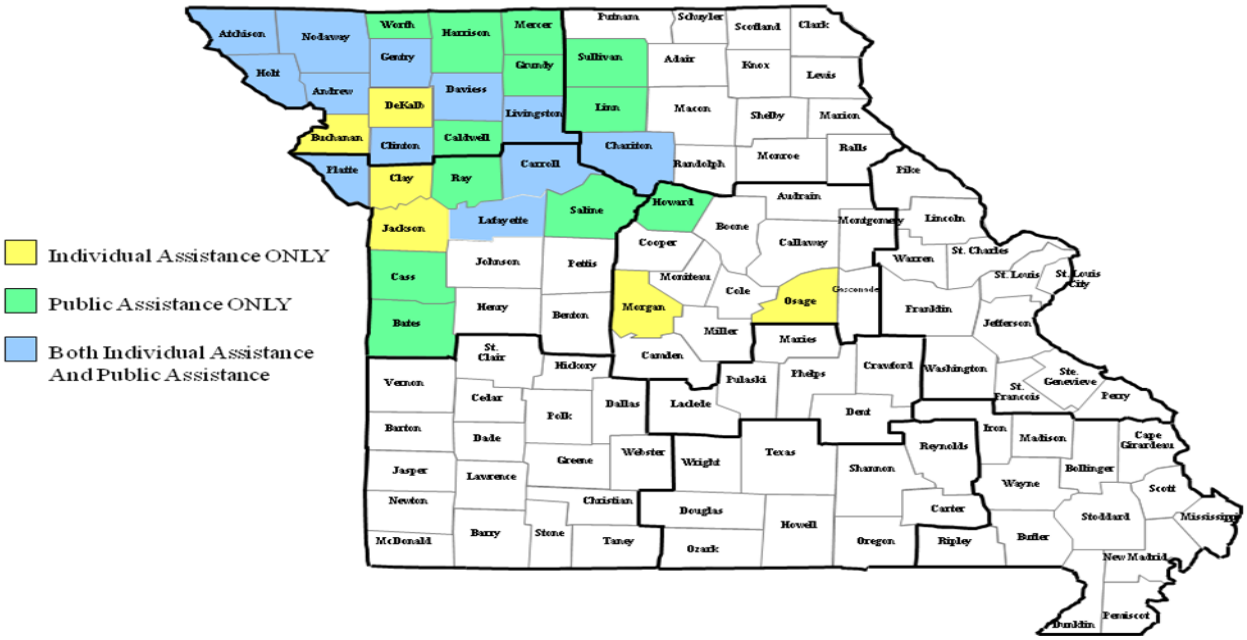


FIGURE B-4

Missouri Disaster Declaration DR-1728
Severe Storms and Flooding
Incident Period: August 19 – 21, 2007
Declared: September 21, 2007

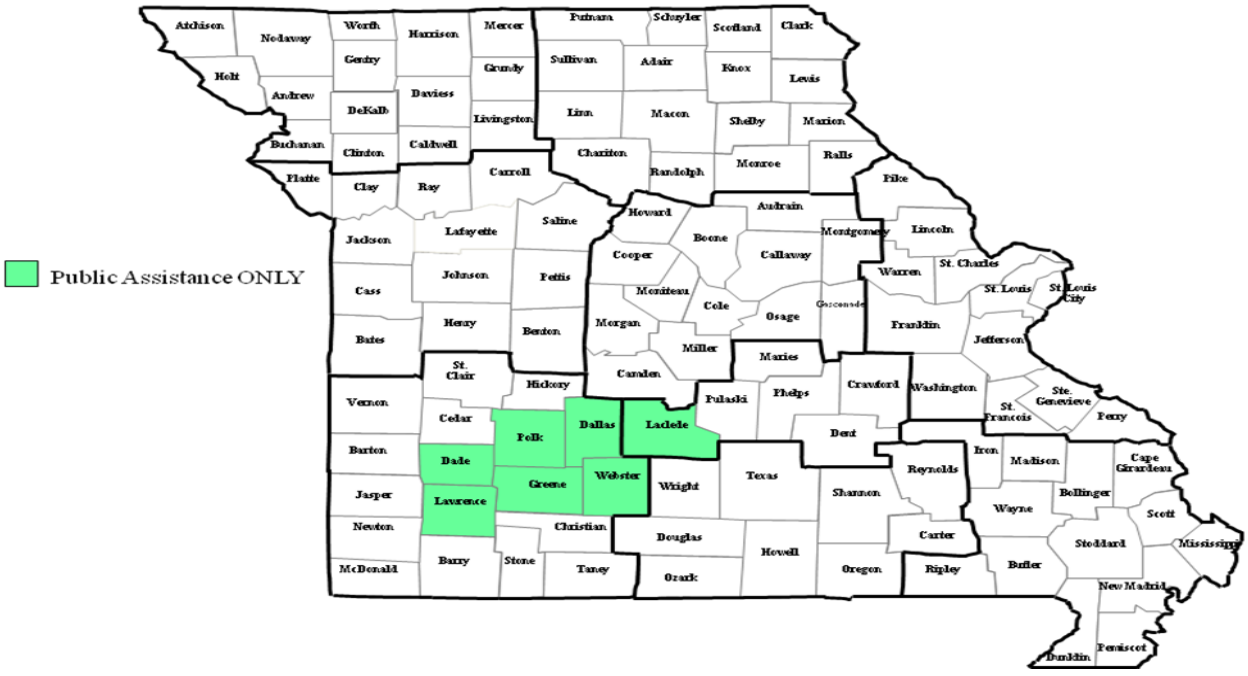


FIGURE B-5

Missouri Disaster Declaration DR-1749
Severe Storms and Flooding
Incident Period: March 17 thru May 9, 2008
Declared: March 19, 2008

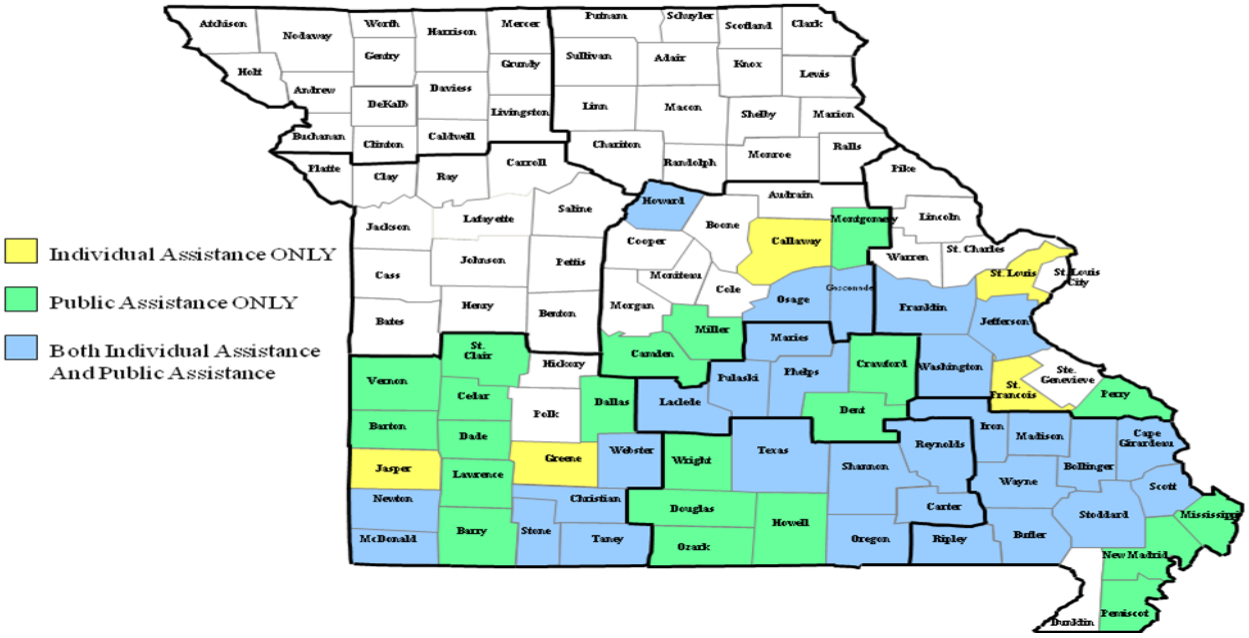


FIGURE B-6

Missouri Disaster Declaration DR-1773
Severe Storms and Flooding
Incident Period: June 1 thru August 13, 2008
Declared: June 25, 2008

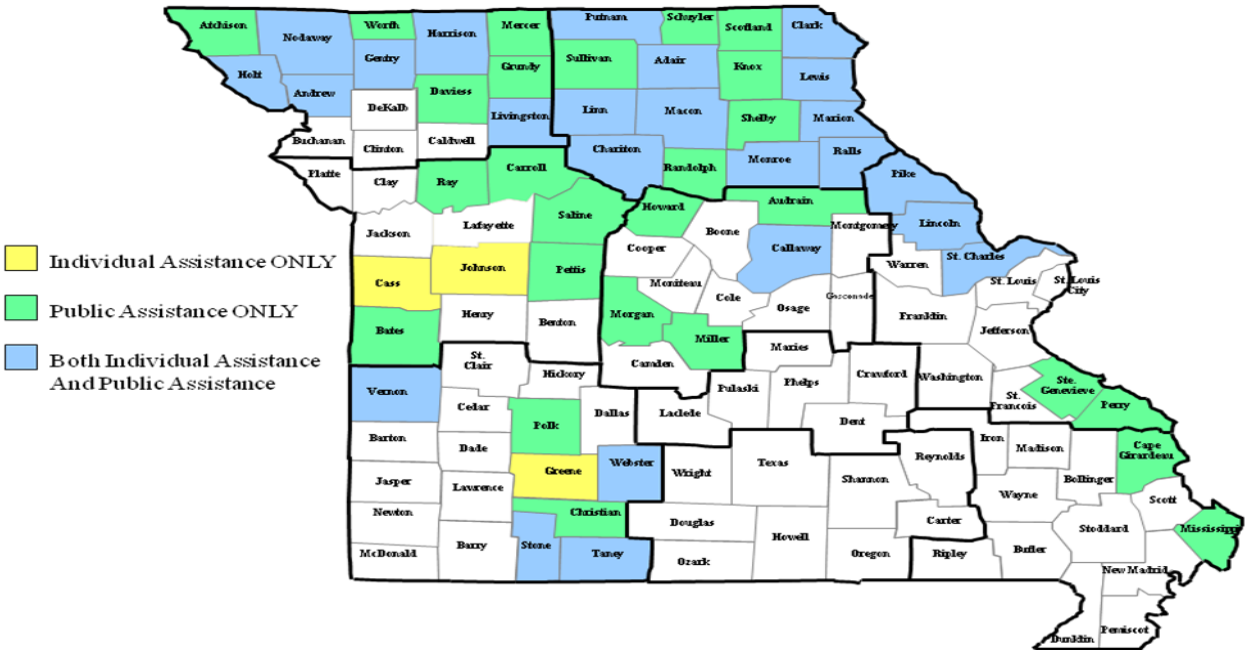
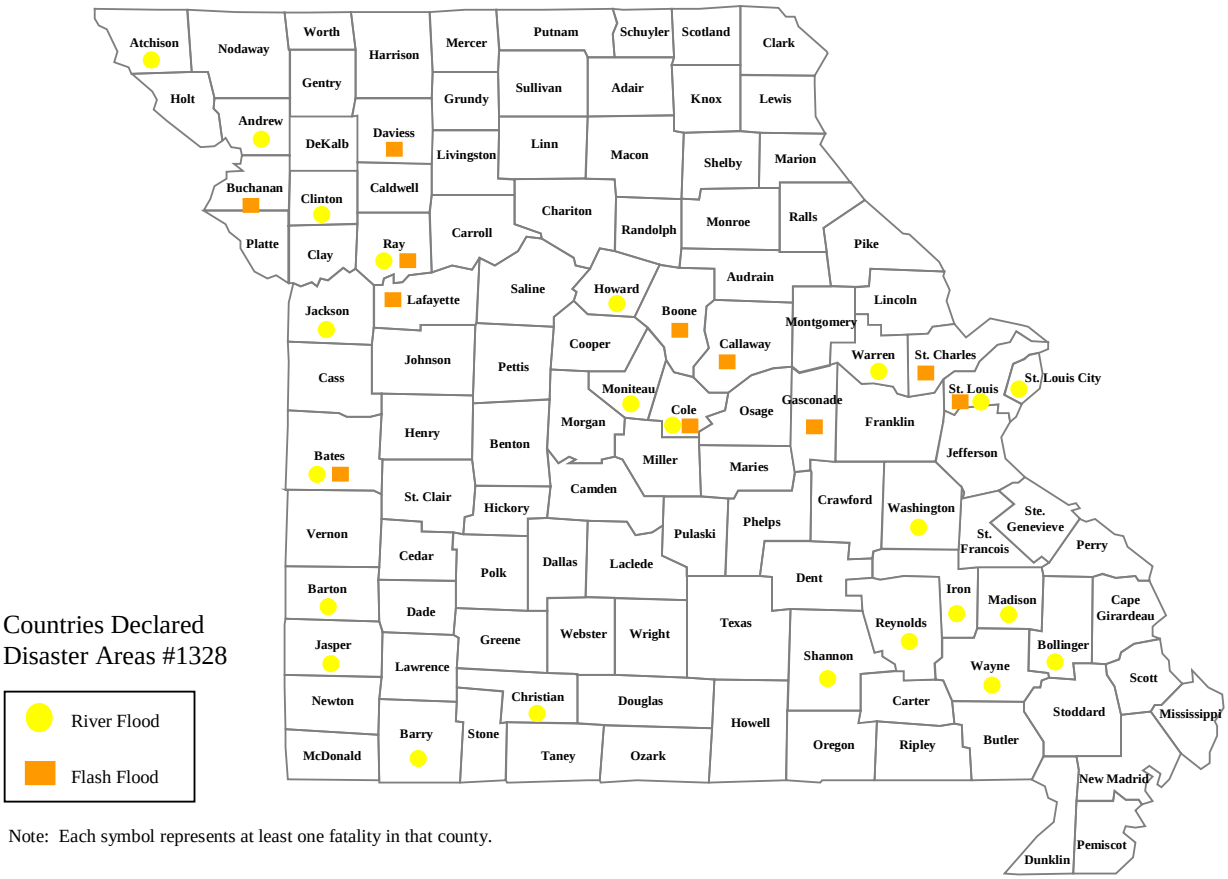


FIGURE B-7

FLOOD-RELATED MORTALITY
MISSOURI 1993



Note: Each symbol represents at least one fatality in that county.

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ANNEX C

SEVERE WINTER WEATHER
(SNOW, ICE, AND EXTREME COLD)

TYPE OF HAZARD

Severe Winter Weather (Snow, Ice, and Extreme Cold)

DESCRIPTION OF HAZARD

Severe winter weather, including snowstorms, ice storms, and extreme cold, can affect any area of Missouri. The greatest threat is likely to occur in the area north of the Missouri River, and can stretch into other areas of the state. Severe weather, such as snow, ice storms, and extreme cold can cause injuries, deaths, and property damage in a variety of ways. Winter storms are considered deceptive killers. This is because most deaths are indirectly related to the storm. Causes of death range from traffic accidents due to adverse driving conditions such as icy roads, to heart attacks caused by overexertion while shoveling snow and from other related activities. Hypothermia or frostbite may be considered the most direct cause of death and injury that can be attributed to winter storms or severe cold. Economic costs are also difficult to measure. Heavy accumulations of ice can bring down trees, electric power lines and poles, telephone lines, and communications towers. Such power outages create an increased risk of fire, as home occupants use alternative fuel sources (wood, kerosene, etc. for heat, and fuel-burning lanterns or candles for emergency lighting). These storms can also affect utility and city operations due to debris removal and landfill hauling. Electrical sparks may ignite blazes that damage or destroy property. Crops and trees can be damaged, and livestock can be killed or injured due to deep snow, ice, or severe cold. Buildings and automobiles may be damaged from falling tree limbs, power lines, and poles. Local governments, home and business owners, and utility companies are faced with spending millions of dollars to restore services, infrastructure, and debris removal. Federal public assistance for local governments and individual assistance for citizens and businesses under the Federal Presidential Disaster Declaration program can help to cover much of the expense.

The types of watches and warnings during severe winter weather are listed below:

Winter Weather Advisory	Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.
Winter Storm Watch	Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.
Winter Storm Warning	Severe winter conditions have begun or are about to begin.
Blizzard Warning	Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.

HISTORICAL STATISTICS

Weather data indicate that the Missouri counties north of the Missouri River receive an average annual snowfall of 18 to 22 inches. Counties south of the Missouri River receive an annual average of 8 to 12 inches. The events that involve borderline conditions of freezing rain and ice are highly unpredictable. The durations of the more serious events combined with other factors, such as high winds, are also highly unpredictable. The degree of severity may be localized to a small area due to a combination of climatic conditions.

Besides snow and ice, extremely cold temperatures can produce problems. The wind chill is determined by factoring cold temperatures and wind speed (see Table C-2). For example, when the temperature is 20 °F and the wind speed is 15 mph, the resulting wind chill (what it really feels like) is 6 °F. This type of situation can be dangerous to people outdoors because their bodies can experience rapid heat loss and resulting in hypothermia (abnormally low body temperature). Statistical information regarding hypothermia mortality is provided on Figure 2 at the end of this annex.

An indirect winter hazard that affects Missourians every year is carbon monoxide poisoning. Improperly vented gas and kerosene heaters or the indoor use of charcoal briquettes creates dangerous levels of carbon monoxide. In 1997, 31 cases of carbon monoxide poisoning were reported in Missouri. No deaths were reported from these cases.

The following summaries describe some of the more significant severe winter weather events occurring in Missouri in recent years. (This information was taken from the National Weather Service's "Storm Data and Unusual Weather Phenomena" publication.)

February 15-16, 1993: Central and southern Missouri was covered with up to 21 inches of snow. The airport at Cape Girardeau received 6 inches of snow in 1 hour and 20 minutes.

January 14-20, 1994: Northeast, central, and east-central Missouri experienced overnight low temperatures from below zero to –20 °F. Hundreds of homes and businesses had frozen and busted water pipes. Wind chills, which ranged from -30 to -50 °F, kept schools closed and accounted for 15 people being admitted to local hospitals for hypothermia and frostbite.

January 16-17, 1994: A layer of ice up to 2 inches thick formed over sections of southeast Missouri, followed by 6 to 10 inches of snow. Some areas were without power for more than 24 hours. Roofs collapsed due to the heavy weight of snow and ice.

December 6, 1994: Ice accumulations of 0.5 to 1.0 inch were reported across northwest, north-central, and northeast Missouri. Over 75 percent of the residents in this region were without power. Phone and cable television was also out. A few rural areas were without power for at least seven days. The City of St. Joseph was declared a disaster area by Governor Mel Carnahan because of damages totaling nearly $4 million.

January 18-19, 1995: Central Missouri received heavy snows, dumping 19.7 inches over Columbia alone and setting a new 24-hour snowfall record. Parts of I-70, I-44, and other major highways were closed due to drifting snow. Snow fell at such a fast rate that snowplows and graders became stuck. Almost 5,000 birds were killed when several large chicken and turkey barns collapsed. Thousands of people were without power and telephone service. The Jefferson City and Columbia airports were closed for a time. The University of Missouri at Columbia canceled classes for the first time in nearly 17 years. State offices in Jefferson City were also closed.

October 22-23, 1996: An early snowfall hit the Kansas City area, dumping as much as 8.5 inches of heavy wet snow. Approximately 130,000 residences were without power, and an estimated $1.5 million in property damages were reported.

January 10-13, 1997: Northwest and west-central Missouri experienced overnight low temperatures below zero. No record low temperatures were recorded, but winds gusting up to 30 mph produced afternoon wind chills as low as -30 to -50 °F.

April 10-11, 1997: A spring snowstorm dumped up to 24 inches in extreme north Missouri. Schuyler County alone reported $2 million in damages, most due to the heavy snow causing roofs on farm buildings to collapse.

January 31, 2002: A massive severe winter storm system dumped snow and ice from Oklahoma to Kansas and into central and northern Missouri. In Missouri alone, more than 600,000 residents were without power, as ice-encased power lines snapped in fierce winds or were pulled down by falling trees and limbs. Loss of electricity included more than 460,000 people in the Kansas City metro area alone (Jackson, Cass, Clay, and Platte counties). Additionally, residents in a line from Kansas City to the Iowa-Illinois border were without power as rural electric cooperative lines broke as well. Outages ranged from several days to nearly two weeks. Damage to property, power restoration, and the cost of debris removal for local governments was so high that Missouri received a Presidential Disaster Declaration (MO-DR 1403) on February 6, 2002, which ultimately included 43 counties; 26 were designated for both individual and public assistance, and 17 were eligible for individual assistance only. (For a list of all counties declared, see Figure 1 in Section VII.) The total eligible public assistance costs for this disaster ($61.9 million dollars as of August 2002) ranks the 2002 ice storm as Missouri's second most costly disaster to date.

November 30-December 2, 2006: A major winter/ice storm hit a few counties in SW, Central and East Missouri. This was declared on December 29, 2006. A very powerful early season winter storm produced significant amounts of snow and ice across much of the middle of the country on November 30th and December 1st. Over a foot of snow fell from Oklahoma to southeastern Wisconsin and accumulations of sleet and freezing rain in excess of 2 inches were common across eastern Missouri and western Illinois. The last winter weather event of this magnitude occurred on January 1st of 1999. (See Figure C-2)

January, 2007: While January wound up near average for temperatures across the region, the daily swings in temperatures were anything but normal. The first 12 days of the month can be categorized as above normal to much above normal with several days from 10 to 17 degrees above normal. The warm weather led up to one of the worst ice storms in history across the region. Damage estimates were over $40 million dollars for Greene County alone. From the 13th through the 22nd, temperatures were below normal with much below normal temperatures on the 16th and 17th. Near normal or slightly above normal temperatures occurred from the 23rd through the 27th, with much below normal temperatures for the remainder of the month. A second snow and ice storm occurred on the 20th which mainly affected southeast Kansas into west central and central Missouri. January 2007 ended with a quick moving light to moderate snowfall on the afternoon and evening of the 31st**.** General 1 to 3 inch snow amounts occurred throughout the region, with isolated 4 inch amounts. (See Figure C-3)

January 31-February 5, 2011: While blizzard like conditions often occur during periods of a winter storm, the 2011 storm was a very rare blizzard din Missouri. Sleet and snow accumulation ranged from 2 to 22 inches across the state with ice reported in the Bootheel. The Missouri National Guard worked with local officials and assisted local jurisdictions with tasks such as health and wellness checks. The State of

Missouri received an Emergency Declaration (EM-3317) for Direct Federal Assistance on February 3rd. On February 4th, the Governor directed the Missouri Department of Transportation to assist with clearing snow from roadways in at least 44 Missouri Counties. On March 23rd the State of Missouri received a Presidential Disaster Declaration (DR-1961) for Public Assistance.

MEASURE OF PROBABILITY AND SEVERITY

It is quite difficult to make an objective and quantitative measure of the probability and severity of snowstorms, ice storms, and extreme cold. Therefore, any analysis should be considered subjective and qualitative.

For areas north of the Missouri River, the probability of a snowstorm, ice storm, or extreme cold should be considered high due to historically higher average snowfall and lower average temperatures. However, the severity is rated moderate due to the overall level of preparedness in this area. For example, homes and businesses may be better insulated due to the higher probability of severe cold relative to other areas. Also, people living in this area may be more likely to use snow tires or purchase four-wheel-drive vehicles. People living in this area may be more likely to maintain adequate supplies of home heating fuels and consider other preparedness measures. Local and state governments may have access to more snow clearing equipment and maintain adequate supplies of materials needed for snow or ice removal. School districts and businesses may be more likely to develop and use snow routes or establish closing procedures.

Areas south of the Missouri River have a low probability of a snowstorm, ice storm, or extreme cold due to their lower average snowfalls and temperatures. However, such events in these areas have a moderate potential severity. This may be due to a lower level of preparedness. People living in this area may have homes with inadequate insulation or fail to maintain an adequate supply of home heating fuels. People may be less likely to equip their vehicles with snow tires or purchase four-wheel-drive vehicles. Local and state governments may not maintain sufficient amounts of equipment and materials. Schools and businesses may not have formal snow routes or closing procedures.

IMPACT OF THE HAZARD

People are adversely affected by winter storms, ice storms, and extreme cold, some more than others. Observations by the National Oceanic and Atmospheric Administration (NOAA) indicate that of winter deaths related to exposure to cold, 50 percent were over 60 years old, over 75 percent were male, and about 20 percent occurred in the home. Of winter deaths related to ice and snow, about 70 percent occur in automobiles, and 25 percent are people caught in storms. As noted earlier, ice storms can result in significant economic costs to homeowners, business owners, and utility companies. The ice storm in December 1994 demonstrated the environmental damage that can occur. Thousands of trees and plants were cut down or damaged as a result of the ice storm. The problem of debris clearance caused environmental impacts due to the permitted burning of debris or reduced landfill space.

SYNOPSIS

As noted in this report, snowstorms, ice storms, and extreme cold can interact to cause many hazards. Only a few degrees may be the difference between rain, ice, or snow. Duration and intensity of any of these events will determine the overall impact of a particular event. Wind speed may be the difference between a minor snow or a blizzard. These events cannot be prevented. Preparedness for these events may be the greatest single factor to reduce loss of life, injury, and property damage. NOAA weather broadcasts via radio and television provide important information for people to prepare and thus reduce risks to their lives and property.

MAPS OR OTHER ATTACHMENTS

Disaster Declarations for Severe Winter Storms: Table C-1

(MO-DR 1403): Counties declared for Individual Assistance and Public Assistance from the January 2002 ice storm are shown on Figure C-1.

(MO-DR 1673): Counties declared for Public Assistance from the Nov 30 – Dec 2, 2006 Severe Winter Storms are shown on Figure C-2.

(MO-DR 1676): Counties declared for Public Assistance from the January 12 – 22, 2007 Severe Winter Storms and Flooding are shown on Figure C-3.

(MO-DR-1736): Counties declared for Public Assistance from the December 6 – 15, 2007 Severe Winter Storms are shown on Figure C-4.

(MO-DR-1748): Counties declared for Public Assistance from the February 10 – 14, 2008 Severe Winter Storms and Flooding are shown on Figure C-5.

(MO-DR-1822): Counties declared for Public Assistance from the January 26 – 28, 2009 Severe Winter Storm are shown on Figure C-6.

(MO-DR-1961): Counties declared for Public Assistance from the January 31 – February 5, 2011 Severe Winter Storms and Snowstorm are shown on Figure C-7.

Number of Deaths due to Hypothermia are shown on Figures C-8 through C- 11 (within text)(data retrieved from Mo Dept. of Health and Senior Services – Bureau of Environmental Epidemiology)

Wind Chill Chart: Table C-2 (within text)

Hypothermia: Hypothermia is defined as a cold injury associated with a fall of body temperature to less than 94.1ºF, which results from unintentional exposure to a cold environment. As of 2013(preliminary data), in Missouri, 595 people have died from the cold during the winter months since 1979 when data collection of hypothermia first began in Missouri. There were 34 deaths during the 2006-2007 cold weather season and 30 deaths during the 1983-1984 season.

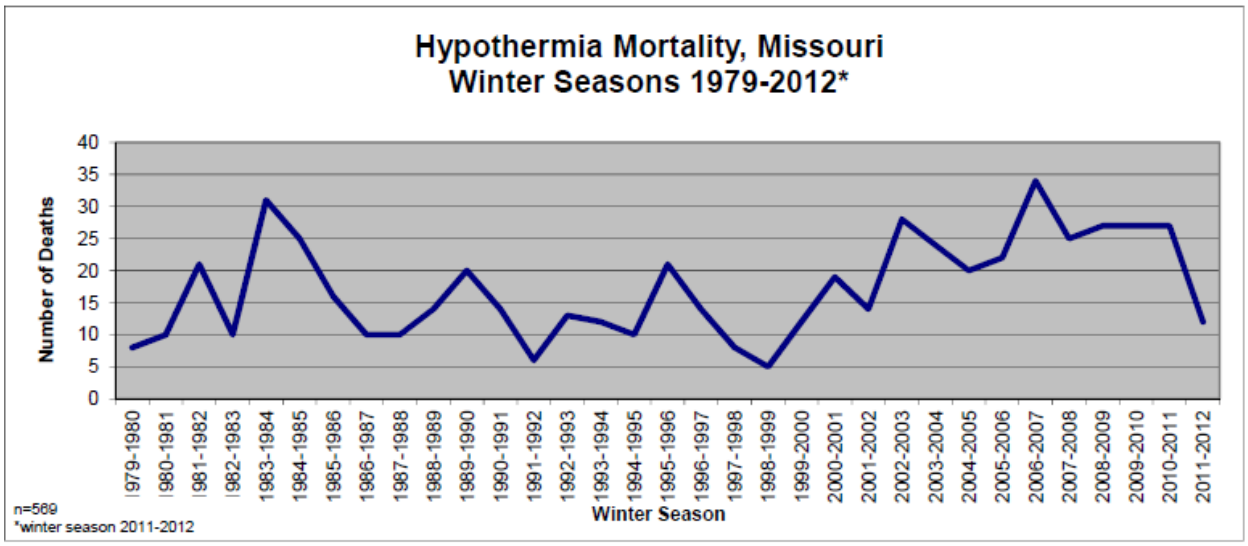


Figure C-8

The elderly are more likely to be victims of cold-related illness resulting in death. Too often handicapped or elderly individuals fall outside their homes and are unable to reach shelter or help. During the cold weather seasons 1989-2012 , 186 (45%) hypothermia deaths were of people age 65 years and older. Deaths of individuals between the ages of 25-64 often have a contributing cause of substance abuse or a debilitating medical condition. Since 1989, there have been 208 (50%) hypothermia deaths in this population. Fortunately, deaths in people age <25 years are rare, accounting for only 20 (5%) of the total 414 Missouri hypothermia deaths for the 1989-2012 .

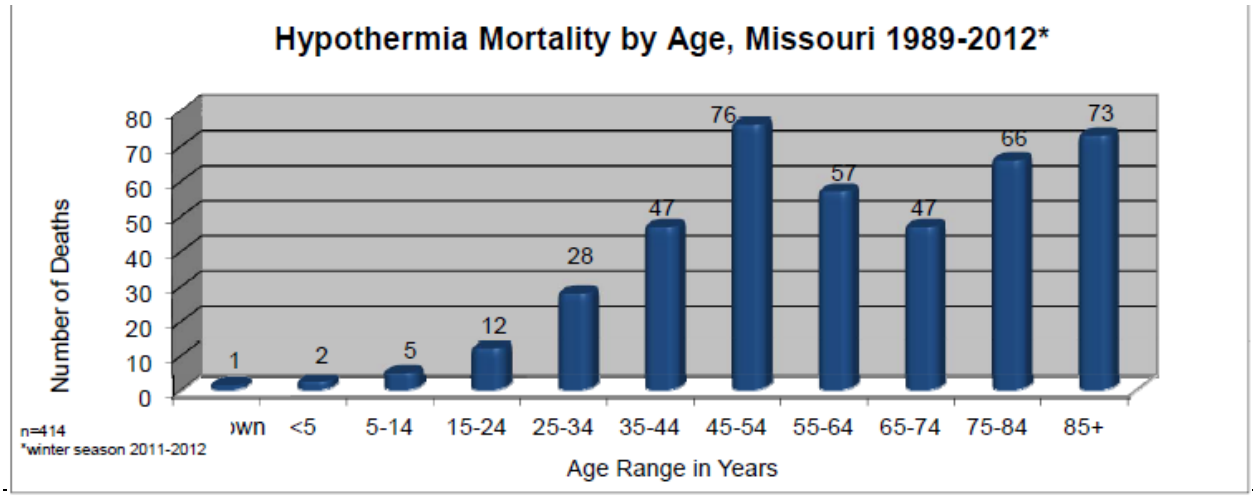


Figure C-9

The majority, 55.8 %, of hypothermia deaths occurred in the non-metropolitan areas of Missouri. Jackson County had 14.7 % deaths, St. Louis County had 10.4 %, and St. Louis City had 19.1 % of the total 414 hypothermia deaths from 1989-2012.

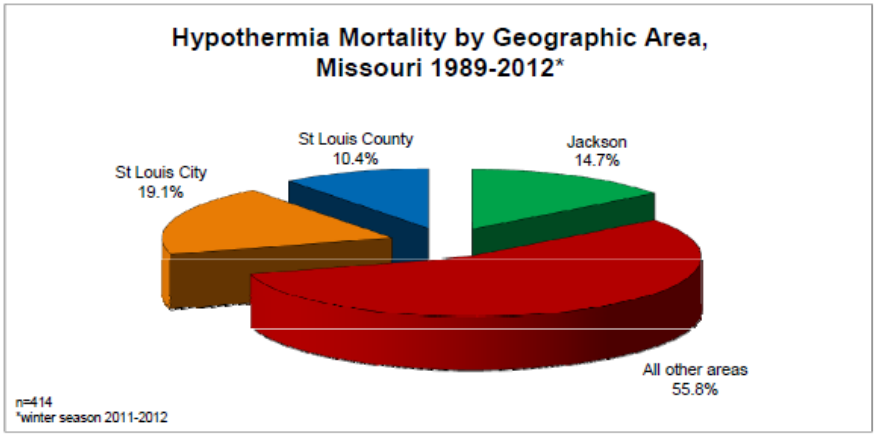


Figure C-10

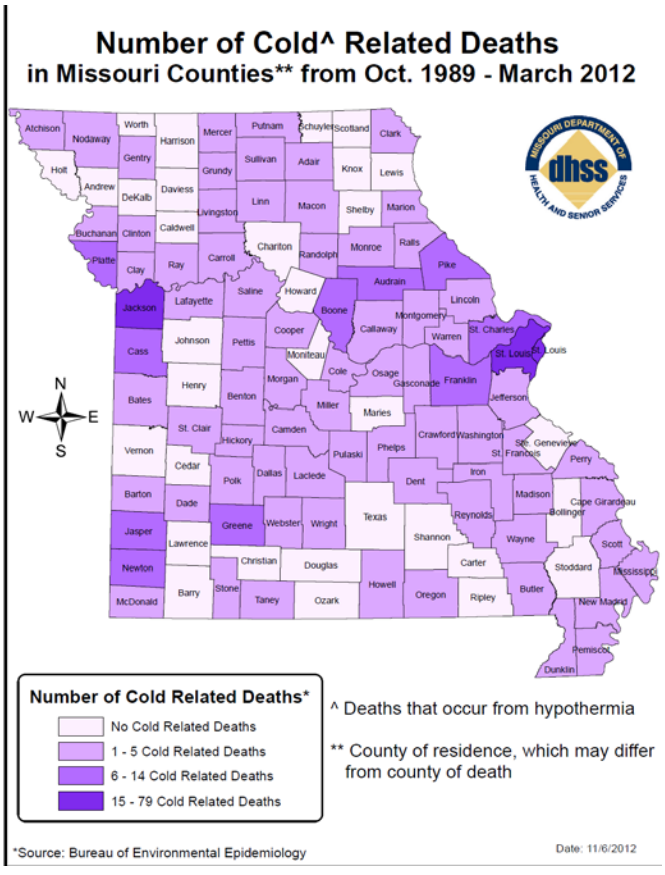


Figure C-11

New Wind Chill Chart: In 2001, the National Weather Service implemented a replacement Wind Chill Temperature (WCT) index for the 2001-2002 winter season (see Table C-2). The reason for the change was to improve the current WCT index used by the NWS and the Meteorological Services of Canada (MCS, the Canadian equivalent of the NWS), which was based on scientific research and a previous index from 1945.

The new formula makes use of advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. In addition, clinical trials have been conducted, and the results of those trials have been used to verify and improve the accuracy of the new formula. The new WTC index incorporates the following factors:

- Uses wind speed calculated at the average height (5 feet) of the human body's face, instead of 33 feet (the standard anemometer height)
- Is based on a human face model
- Incorporates modern heat transfer theory (heat loss from the body to its surroundings during cold and breezy/windy days)
- Lowers the calm wind threshold to 3 mph
- Uses a consistent standard for skin tissue resistance
- Assumes the worst-case scenario for solar radiation (clear night sky).

Table C-2

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

National Weather Service. Storm Data and Unusual Weather Conditions. www.nws.noaa.gov.

TABLE C-1

DISASTER DECLARATIONS FOR SEVERE WINTER STORMS, ICE STORMS, AND SNOWSTORMS

January 29-February 13, 2002 DR-1403	Ice Storm	Adair, Audrain, Barton, Bates, Benton, Boone, Buchanan, Caldwell, Carroll, Cass, Cedar, Chariton, Clark, Clay, Clinton, Cooper, Daviess, DeKalb, Grundy, Henry, Howard, Jackson, Johnson, Knox, Lafayette, Lewis, Linn, Livingston, Macon, Marion, Monroe, Morgan, Pettis, Platte, Ralls, Randolph, Ray, St. Clair, Saline, Scotland, Shelby, Sullivan, and Vernon Counties Bates, Carroll, Cass, Cedar, Chariton, Clay, Clinton, Henry, Howard, Jackson, Johnson, Knox, Lafayette, Lewis, Linn, Macon, Marion, Monroe, Pettis, Platte, Randolph, Ray, St. Clair, Saline, Shelby, and Vernon Counties	IA PA
November 30-December 2, 2006 DR-1673	Severe Winter Storm	Boone, Callaway, Camden, Cole, Greene, Iron, Marion, Miller, Reynolds, St. Francois, St. Louis City, St. Louis Co., Ste. Genevieve, and Washington Counties	PA Only
January 12-22, 2007 DR-1676	Severe Winter Storms & Flooding	Barry, Benton, Boone, Camden, Cedar, Christian, Crawford, Dade, Dallas, Franklin, Gasconade, Greene, Hickory, Jasper, Laclede, Lawrence, Maries, McDonald, Miller, Newton, Osage, Phelps, Polk, Pulaski, St. Clair, Stone, Texas, Webster, and Wright Counties	PA Only
December 6-15, 2007 DR-1736	Severe Winter Storm	Adair, Andrew, Atchison, Audrain, Barton, Benton, Boone, Buchanan, Caldwell, Callaway, Camden, Cedar, Clinton, Cole, Dade, Daviess, DeKalb, Gentry, Grundy, Harrison, Hickory, Holt, Jasper, Lincoln, Linn, McDonald, Mercer, Miller, Moniteau, Montgomery, Morgan, Newton, Nodaway, Osage, Pike, Putnam, St. Clair, Schuyler, Scotland, Sullivan, Warren, and Worth Counties	PA Only
February 10-14, 2008 DR-1748	Severe Winter Storms & Flooding	Bollinger, Butler, Cape Girardeau, Carter, Christian, Douglas, Greene, Madison, Mississippi, Ozark, Reynolds, Scott, Shannon, Stoddard, Texas, Wayne, Webster, and Wright Counties	PA Only
January 26-28, 2009 DR-1822	Severe Winter Storm	Barry, Bollinger, Butler, Cape Girardeau, Carter, Dunklin, Howell, Madison, Mississippi, New Madrid, Oregon, Ozark, Pemiscot, Reynolds, Ripley, Scott, Shannon, Stoddard, Stone, Taney, and Wayne Counties	PA Only

January 31-February 5, 2011 DR-1961	Severe Winter Storm and Snowstorm	Adair, Andrew, Audrain, Barton, Bates, Benton, Boone, Buchanan, Caldwell, Callaway, Camden, Carroll, Cass, Cedar, Chariton, Clark, Clinton, Cole, Cooper, Dade, Dallas, DeKalb, Grundy, Henry, Hickory, Howard, Johnson, Knox, Laclede, Lafayette, Lewis, Linn, Livingston, Macon, Madison, Maries, Marion, McDonald, Miller, Moniteau, Monroe, Montgomery, Morgan, Newton, Osage, Pettis, Pike, Platte, Polk, Pulaski, Putnam, Ralls, Randolph, Ray, St. Clair, Saline, Schuyler, Scotland, Shelby, Sullivan, Vernon, and Worth Counties	PA Only

Notes:

IA Individual Assistance
PA Public Assistance
SBA Small Business Administration

FIGURE C-1

Missouri Disaster Declaration DR-1403
Ice Storm
Incident Period: January 29 thru February 13, 2002
Declared: February 6, 2002

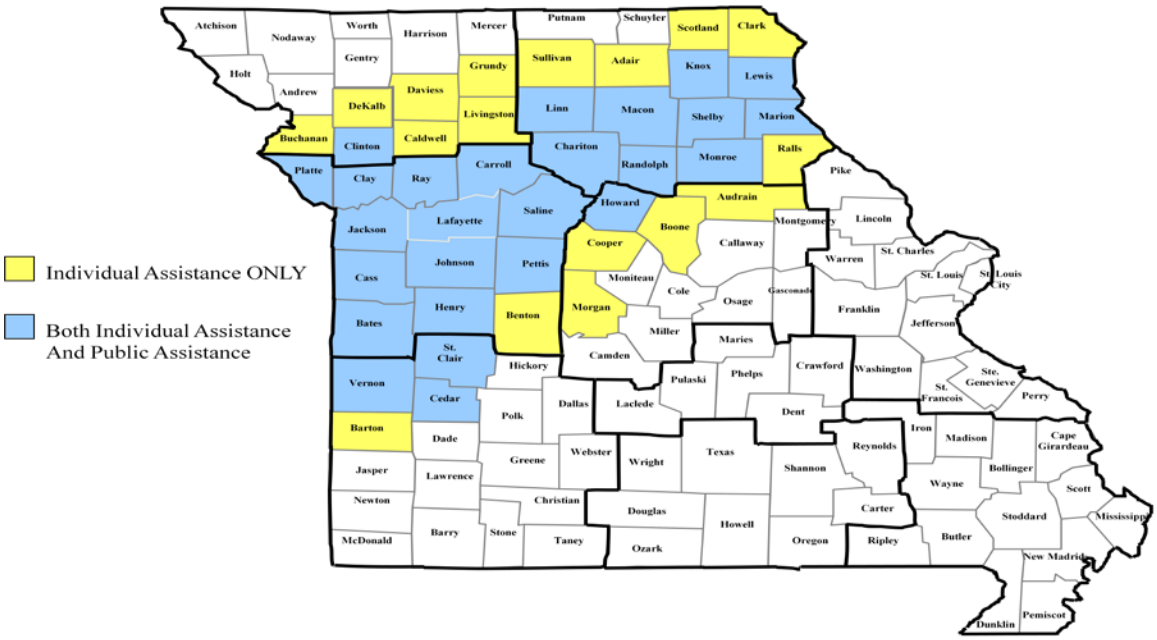


FIGURE C-2

Missouri Disaster Declaration DR-1673
Severe Winter Storms
Incident Period: November 30 thru December 2, 2006
Declared: December 29, 2006

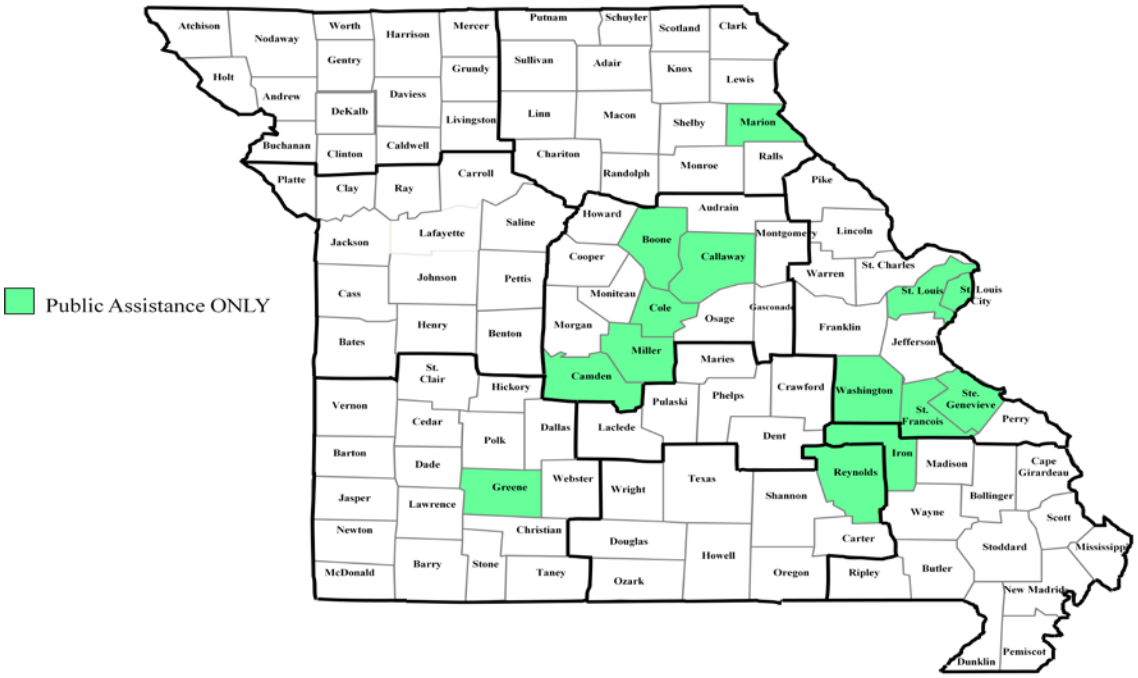


FIGURE C-3

Missouri Disaster Declaration DR-1676
Severe Winter Storms and Flooding
Incident Period: January 12 – 22, 2007
Declared: January 15, 2007

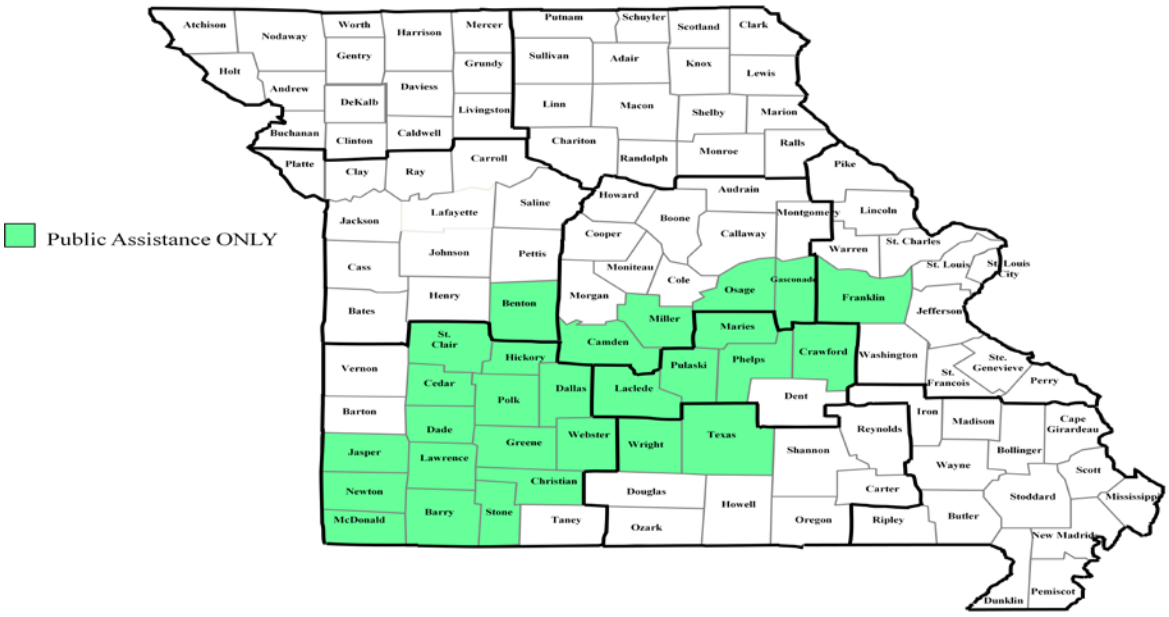


FIGURE C-4

Missouri Disaster Declaration DR-1736
Severe Winter Storms
Incident Period: December 8 – 15, 2007
Declared: December 12, 2007

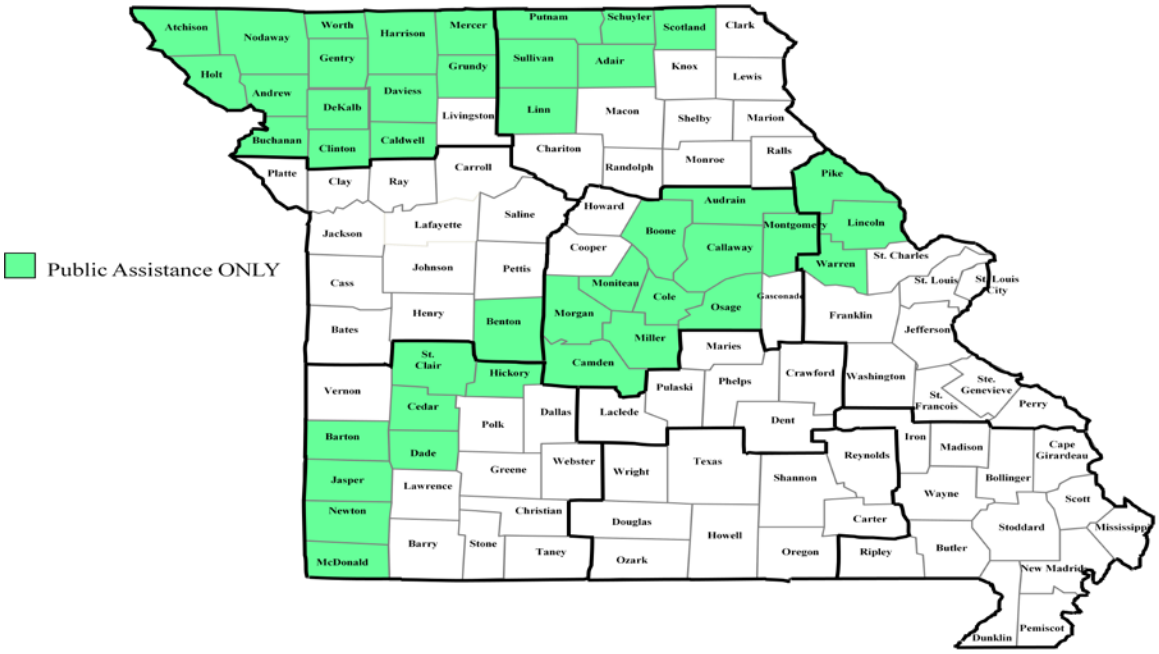


FIGURE C-5

Missouri Disaster Declaration DR-1748
Severe Winter Storms and Flooding
Incident Period: February 10 – 14, 2008
Declared: March 12, 2008

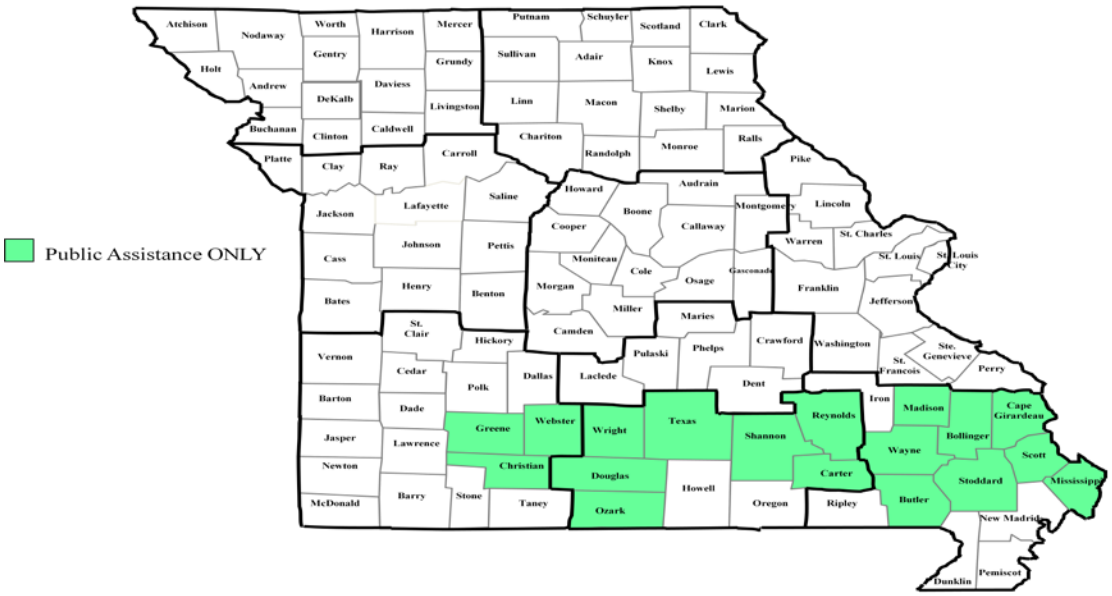


FIGURE C-6

Missouri Disaster Declaration DR-1822
Severe Winter Storms
Incident Period: January 26 - 28, 2009
Declared: February 17, 2009

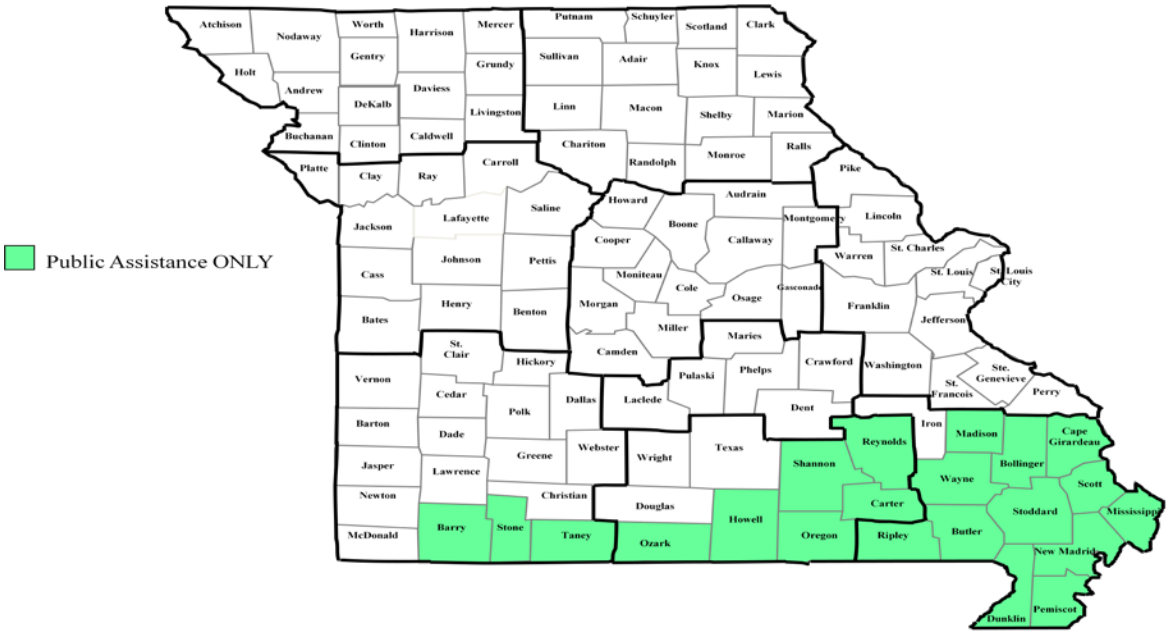
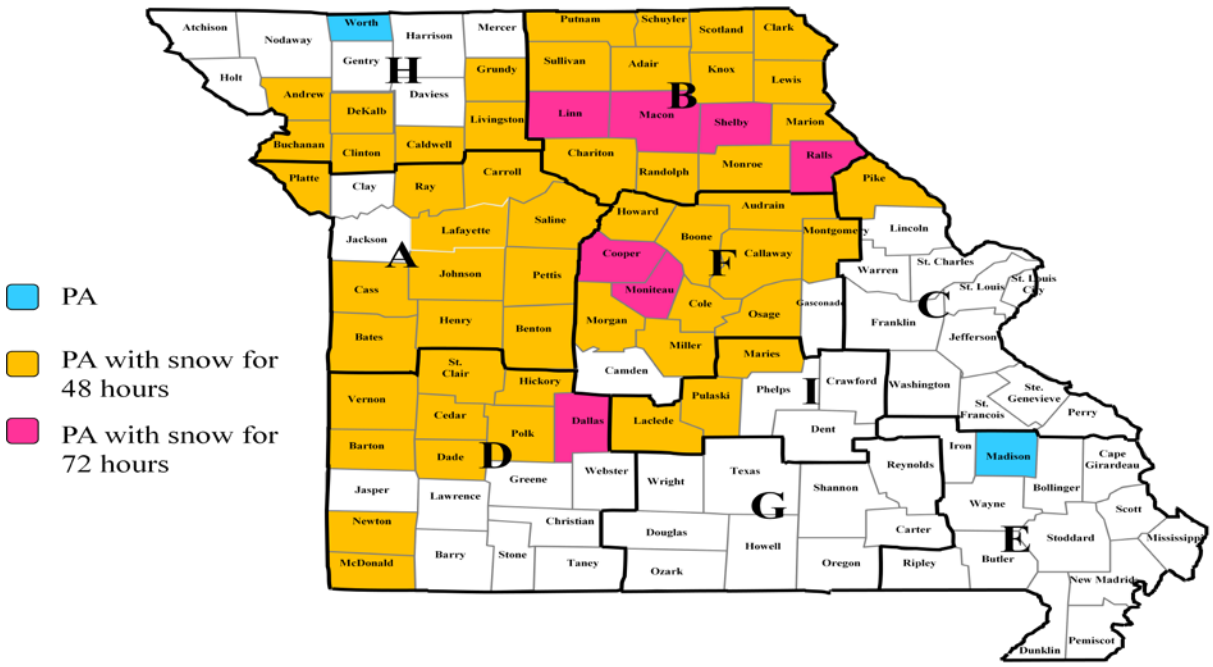


FIGURE C-7

Missouri Disaster Declaration DR-1961
Severe Winter Storm and Snowstorm
Incident Period: January 31 to February 5, 2011
Declared: March 23, 2011



ANNEX D

DROUGHT

I. TYPE OF HAZARD

Drought

II. DESCRIPTION OF HAZARD

Drought is not a hazard that affects just farmers, but can impact the nation's entire economy. Its outcome can adversely affect a small town's water supply, homeowners, the corner grocery store, commodity markets, and tourism. According to the National Drought Mitigation Center, drought costs the U.S. economy about $7 to 9 billion dollars a year. Losses from the 1988-1989 droughts were projected by Changnon and Riebsame and White House Study Group at $39.2 billion for 1988, including about $51.6 billion in agricultural losses. The University of Missouri estimated the drought losses of 2002 and 2003 farm production years. Economic impacts to the Missouri economy due to agricultural losses were $461 million for 2002 and $575 million in 2003.

2012 was the hottest year on record in the lower 48 states,(NDMC). The USDA - Economic Research Service states that the 2012 drought is "the most severe and extensive drought in at least 25 years is seriously affecting U.S. agriculture, with impacts on the crop and livestock sectors and with the potential to affect food prices at the retail level."

The USDA- Risk Management Agency reported on January 15, 2012 that: "insurance claims for all crops in 2012 has reached $11.581 billion the highest ever". The Missouri Soil and Water Program has distributed more than $21 million in immediate water supply assistance since August 2012 to help livestock and crop producers find new water supplies or improve their existing farm and ranch water systems. A total of 201 emergency cost share water connections were approved in Missouri for livestock producers. The State of Missouri cost share program funded over 2000 new water wells to assist in alleviating impacts of the drought.

The dictionary defines drought as a period of prolonged dryness. The Missouri Drought Response Plan revised in 2002 distinguishes between five "categories" of drought:

1. **Agricultural Drought** - defined by soil moisture deficiencies.

2. **Hydrological Drought** - defined by declining surface and groundwater supplies.

3. **Meteorological Drought** - defined by precipitation deficiencies.

4. **Hydrological Drought & Land Use -** defined as a meteorological drought in one area that has hydrological impacts in another area.

5. **Socioeconomic Drought -** defined as drought that impacts supply and demand of some economic commodity.

Each of these definitions relates the occurrence of drought to water shortfall in some component of the hydrological cycle. Each affects patterns of water and land use, and each refers to a

repetitive climatic condition. Agriculture is often the first sector to be impacted by drought because access to water resources and soil moisture reserves determine crop productivity. Drought in the agricultural sense does not begin with the cessation of rain, but rather when available stored water will support actual evapotranspiration (WMO, 2010). In agricultural areas, drought during the planting and growing season can have a significant impact on yield. "The amount of available soil moisture in the root zone is a more critical factor for crop growth than the actual amount of precipitation deficit or excess. The soil moisture deficit in the root zone during various stages of the crop growth cycle has a profound impact on the crop yield." (WMO, 2010).

In urban areas, drought can affect those communities that depend on reservoirs for water, and decreased water levels due to insufficient rain can lead to restricted water use.

Regardless of the specific definition, droughts are difficult to predict or forecast, both as to when they will occur and how long they will last. According to Dr. Grant Darkow, Department of Atmospheric Science, University of Missouri-Columbia, there is a recognizable "upper air-flow pattern and simultaneous surface pattern associated with abnormal dryness over Missouri." When the upper air-flow pattern is typified by air flowing in a broad arc over the central plains with higher speeds in southern Canada than over the U.S., then the air over the southern plains will be "characterized by a weak clockwise circulation." Storm systems coming off the Pacific Ocean will cross the extreme northwestern states and southern Canada, thus bypassing the Midwestern states. When this flow pattern persists, the result can be a prolonged period of drought.

A historic indicator of drought and one keyed to the Missouri Drought Plan is the Long Term Palmer Drought Severity Index (PDSI), which is published jointly by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture (USDA) (see Table D-1). The PDSI measures the difference between water supply (in terms of precipitation and stored soil moisture) and demand (the amount of water required to recharge soil and keep rivers, lakes and reservoirs at normal levels). The result is a scale from +4 to -4, at 1.0 and 0.5 intervals. By relating the PDSI to a regional index, one can compile data that reflects long-term wet or dry tendencies.

TABLE D-1

PALMER DROUGHT SEVERITY INDEX (PDSI)

PDSI Number	Long-Term Tendency
Above 4.0	Extreme moist spell
3.0 to 3.9	Very moist spell
2.0 to 2.9	Unusually moist spell
1.0 to 1.9	Moist spell
0.5 to 0.9	Incipient moist spell
0.4 to -0.4	Near normal conditions
-0.5 to -0.9	Incipient drought
-1.0 to -.9	Mild drought
-2.0 to -2.9	Moderate drought
-3.0 to -3.9	Severe drought
Below -4.0	Extreme drought

For PDSI reporting purposes, Missouri is divided into six regions of similar climatic conditions: Northwest, Northeast, West Central, Southwest, Southeast, and Bootheel.

These regions are illustrated on Figure D-1 (Palmer Drought Severity Index, Missouri Sub regions) in Section VII of this annex.

In addition to the NOAA/USDA indices, water management agencies in Missouri have access to the Missouri Crop Progress and Condition Report, produced by the Missouri Agricultural Statistics Service. These reports provide detailed statistical information on weather conditions, crop conditions, topsoil moisture supply, and subsoil moisture supply by sub region throughout Missouri.

Other less quantitative indicators of drought include high water demand versus available supplies, reduced stream flows, declining reservoir levels, precipitation deficits, falling water levels in wells, and low soil moisture.

The difficulty with recognizing or predicting drought is that no single indicator can be reliably used to predict onset. Regional indicators such as the PDSI are limited in that they respond slowly to deteriorating conditions, whereas observations of surface conditions and groundwater measurements or rainfall may only provide a "snapshot" of a very small area.

Consequently, the use of a variety of drought indicators is essential for effective assessment of drought conditions, and the PDSI is the primary means to assess drought severity.

Missouri's Drought Response System is divided into four phases:

1. **Phase I - Advisory Phase:** Requires a drought monitoring and assessment system to provide enough lead time for state and local planners to take appropriate action.

2. **Phase II - Drought Alert:** When the PDSI reads -1.0 to -2.0, and stream flows, reservoir levels, and groundwater levels are below normal over a several month period, or when the Drought Assessment Committee (DAC) determines that Phase II conditions exist based on other drought determination methods.

3. **Phase III - Conservation Phase:** When the PDSI reads -2.0 to -4.0, and stream flows, reservoir levels, and groundwater levels continue to decline, along with forecasts indicating an extended period of below-normal precipitation, or when the DAC determines that Phase III conditions exist based on other drought determination models.

4. **Phase IV - Drought Emergency:** When the PDSI is lower than -4.0, or when the DAC determines that Phase IV conditions exist based on other drought determination methods.

III. HISTORICAL STATISTICS

According to the 2004 revision of the Missouri Climatic Atlas for Design of Land Application Systems 9MDNR-WP-1400) Missouri's average annual rainfall ranges from about 33.6 inches in the northwest to about 51 inches in the southern tier of the Missouri Bootheel. Even the driest areas of Missouri have more rainfall than most western states; however, lack of rainfall impacts

certain parts of the state more than others because of alternate source availability and usage patterns.

Southern Missouri—Most of the southern portions of Missouri are less susceptible to problems caused by prolonged periods without rain because of abundant groundwater resources in the region. Even with decreased stream flows or lowered reservoir levels, groundwater is still a viable resource in southern Missouri. Row-crop farming is not extensive, and therefore agricultural needs aren't as great as in other parts of the state. The only exception is in the southwestern and southeastern areas where irrigation is used.

Northern and West Central Missouri—Most of the northern and west-central portions of Missouri are underlain by rocks that are not conducive to water-bearing formations. They yield only small amounts of water, even during periods of normal and above-normal rainfall. Under drought conditions, adequate amounts of water cannot be pumped from the rock formations of northern Missouri to supply even domestic needs. Most streams in northern Missouri do not receive appreciable groundwater recharge. During periods of drought, these streams are generally reduced to a series of pools, or may become completely dry. Streams and water impoundments are the only localized sources of water during droughts, and even these limited resources are at risk when the drought is prolonged. Agriculture in west-central and northern Missouri is usually the first to feel the effects of drought. Although row-cropping is more extensive in this part of the state, irrigation is generally not feasible except on the floodplains of major rivers.

Drought of 1999-2000

Most of Missouri, along with other states, was in a drought condition during the last half of 1999. The dryness did not begin until July 1999, but rapidly developed into a widespread drought by September. At that time, Missouri was placed under a Phase I Drought Advisory level by the Department of Natural Resources (DNR), and Governor Carnahan declared an Agricultural Emergency for the entire state. Agricultural reporting showed a 50 percent crop loss from the drought in 50 counties, with severe damage to pastures for livestock, corn crops, and Missouri's top cash crop–soybeans. On October 13, 1999, U.S. Agriculture Secretary Dan Glickman declared all Missouri counties agricultural disaster areas, making low-interest loans available to farmers in Missouri and contiguous states. The drought intensity increased through autumn and peaked at the end of November 1999. In fact, the five-month span between July and November became the second driest July-November period in Missouri since 1895, averaging only 9.38 inches of rain.

A wetter-than-normal winter diminished dry conditions in central and southern Missouri, but long-term moisture deficits continued to exist. At the same time, the remainder of the state (roughly north of the Missouri River) continued under drought conditions. Overall dry conditions returned through much of the state in March 2000, and costly wildfires and brush fires (70) erupted in many counties. By May, the entire state was under a Phase II Drought Alert level, and on May 23, 2000, Governor Carnahan announced activation of the Missouri Drought Assessment Committee (DAC), made up of state and federal agencies and chaired by Mr. Jeff Staake the DNR Deputy Director. At a meeting on May 25, 2000, the DAC committee selected a subcommittee (guided by the Missouri Drought Response Plan) to determine the drought status of each county. In June 2000, based on observations across the state and projections of future rainfall, the committee upgraded the drought status for 27 northern Missouri counties to Phase III, Conservation. This was based on concerns for water supplies and agricultural impacts. The City of Milan in Sullivan County was among the most severely affected in terms of

water supplies. In June 2000, a total of 80 Missouri counties remained under the Phase II Alert level, while seven counties in southeast Missouri (Butler, Dunklin, Mississippi, New Madrid, Pemiscot, Scott and Stoddard) remained under Phase I Advisory conditions.

By mid-July 2000, some areas of northern Missouri benefited from additional rainfall, while drier conditions prevailed in other areas. At the meeting on July 12, 2000, DAC revised its assessment, placing 30 counties under Phase III Conservation conditions, including 10 counties in the south-central area. The remaining 84 counties in the state were under Phase II Drought Alert conditions. This included seven counties in northern Missouri, which were downgraded from Phase III Conservation, and seven counties in Southeast Missouri, which were previously assessed as Phase I Advisory.

To ease the agricultural impact of the drought during the summer months, Governor Carnahan gained release of over 1 million acres from the Conservation Reserve Program (CRP) to provide farmers and ranchers in 21 counties an additional sources to cut hay for livestock feed. Also, livestock producers in 16 counties were released from CRP contracts to allow cattle grazing on certain idle lands.

Drought of 2002-2004

The drought of 2002 caused tremendous financial hardships to many Missouri crop and livestock producers. The financial impact of the drought on producers in turn impacted the local communities and the state in terms of reduced economic activity. This drought cost an estimated $46 million in 2002 and $575 million for 2003, in terms of Missouri's agricultural and economic productivity.

Drought conditions encompassed most of the northwestern quarter of Missouri. Severe drought conditions affected the northwest, west-central, and some portions of southwest Missouri, causing water conservation measures to be taken and restrictions to be imposed. For some areas, this was the second driest year since 1914; the only drier year was in 1988. This was the driest November – December period on record for northwestern and north-central Missouri in 2002. The drought continued through 2003 and 2004 with conditions improving in 2004. As of March 3, 2004, drought conditions still encompassed most of the northwestern quarter of Missouri with 18 counties designated as being in Phase 3-Conservation Phase. The drought conditions improved due to an increase in precipitation between March and June 2004. In June 2004, Missouri was considered drought free for the first time in three years.

Drought of 2005

The Drought of 2005, as in the previous drought of 2003-2004, caused tremendous hardships to many Missouri crop and livestock producers. According to the University of Missouri's Food and Agriculture Institute (FAPRI), the estimated losses to the corn and hay crops alone will likely top $370 million. For some Missouri farmers this will be a drier year than 1988. By late July, the drought conditions encompassed all but nine counties in the northwestern corner of the state. Severe drought conditions affected counties in the southwest through the northeast part of the state. Effective August 23, 2005, due to the Secretarial disaster designation, 114 Missouri counties and the City of St. Louis were designated as natural disasters for physical and/or production loss loan assistance from Farm Service Agency (FSA). The drought conditions began to improve by late August and into September.

Drought of 2006

The Drought of 2006 has had a tremendous agricultural impact on Missouri farmers. As of September 2006, FSA reported that 26 counties had requested Emergency Conservation Program (ECP) funds with 2 additional counties pending. The livestock industry is feeling severe effects from the current drought. Hay supplies are short and water supplies for livestock continue to decline. USDA reported that the new $50 million program for livestock producers, called the Livestock Assistance Grant Program, will provide this money in Section 32 to states in block grant form. The drought has also had an impact on local water supplies with several communities issuing mandatory conservation measures. The most recent Drought Condition Status Map (August 16, 2006) approved by the Drought Assessment Committee (DAC) indicates that only 10 counties in the southeastern portion of the state were free of drought.

Drought of 2012

The drought of 2012 initiated in May and is continuing through December 20, 2012. The heat and severity of the dryness greatly affected crops and pasture and started an early summer on-set agricultural drought. Water distributors have required conservation measures this summer due to peak water demands exceeding delivery capacity. Some surface water suppliers are concerned that if the dryness continues their ability to meet local water needs will be severely curtailed.

The dryness that started this summer has lowered stream flows, shallow groundwater tables and is now impacting the Missouri and Mississippi Rivers. December is seeing low Mississippi River flows at St. Louis rarely seen in the past and if the 2012 dryness continues into 2013 could reach new record low flows.

IV. MEASURE OF PROBABILITY AND SEVERITY

Because of its geographical location and characteristic weather patterns, Missouri is vulnerable to drought conditions. Agricultural droughts are the most common on record, particularly those inflicting damage to corn crop yields. Throughout much of this century, these droughts have occurred with common regularity (on the average of once every 5 years), according to the Missouri Crop and Livestock Reporting Service.

Based on Midwest drought data, DNR, Water Resources Program produced a Missouri Drought Response Plan in 1995, with revisions in 2002. The plan's primary purpose is to address the need for state and local governments to coordinate advanced emergency planning, as during the drought of 1999-2000. The plan outlines proactive emergency and tactical measures designed to better prepare the state for drought. It also emphasizes the need for long-range strategic planning, which would address the bigger issue of drought impact avoidance. The plan notes that one of the major goals of drought mitigation is to prevent water shortages in the agricultural sector and public water systems.

In preparing the plan, divided the state into three regions, which are prioritized according to drought susceptibility. The regions are identified as having slight, moderate, and severe susceptibility to drought conditions. They are illustrated on Figure D-2 (Drought Susceptibility) in Section VII of this annex. Descriptions of drought susceptibility for the three regions are as follows:

Region A (mostly Southeast Missouri) has very little drought susceptibility. It is a region underlain by sands and gravel (alluvial deposits). Surface and groundwater resources are generally adequate for domestic, municipal, and agricultural needs.

Region B (Central, East-Central Missouri) has moderate drought susceptibility. Groundwater resources are adequate to meet domestic and municipal water needs, but due to required well depths, irrigation wells are very expensive. The topography generally is unsuitable for row-crop irrigation.

Region C (Northern, West-Central Missouri; St. Louis County) has severe drought vulnerability. Surface water sources usually become inadequate during extended drought. The groundwater resources are normally poor, and typically supply enough water only for domestic needs. Irrigation is generally not feasible. When irrigation is practical, groundwater withdrawal may affect other uses. Surface water sources are used to supplement irrigation supplied by groundwater sources.

The Missouri Drought Response Plan relies primarily upon the PDSI to indicate drought severity, and supports its findings directly with stream flow, reservoir-level, and groundwater-level measurements. Actions within the drought plan are triggered when the PDSI reaches certain levels. The DAC, chaired by the Director, or designee of the Department of Natural Resources, is activated in the Phase II Drought Advisory Stage. The DAC then activates the Impact Teams, which cover the topics of agriculture, natural resources and environmental recreation, water supplies, wastewater and health, social, economic, and post-drought evaluations. Areas that appear to be the most vulnerable to drought are the focus of future drought planning, management, and mitigation activities. Based on this information, the State rates the probability and severity of the drought hazard as moderate.

V. IMPACT OF THE HAZARD

A severe drought in the Southern Plains states from the fall of 1995 through the summer of 1996 resulted in more than $1 billion in costs and damages to agricultural regions. The states of Texas and Oklahoma were most severely affected. In the summer of 1993, a combination of drought and a heat wave across the southeast U.S. was responsible for about $1 billion in costs and damages. Among the most costly disasters, however, was the Great Drought of 1988-1989, which caused an estimated $39 billion in losses in the United States. As a comparison, the record floods of 1993 in the Midwest inflicted damage in the range of $12 to $16 billion. Although more subtle in terms of physical damage, the social and economic costs of drought are substantial.

Drought, as it affects the health and safety of Missouri citizens, is primarily a problem of rural water supply. With some exceptions, larger municipalities have not experienced major problems at levels that have caused impacts to some smaller communities. The most seriously affected are those supplied by small water structures. In its scope, a drought may be limited to a localized problem, or even a regional problem. Based on severity and duration, it may even become a statewide problem, at least in terms of overall impact, such as the commitment and shifting of resources and other response issues. Good water quality and a plentiful supply are two factors that we often take for granted. But when good water becomes a scarce commodity and people must compete for the available supply, the importance of these two factors increases dramatically. The State Water Resources Plan (RSMO 640.415), which is a provision of the Water Resources Law enacted by the Missouri Legislature in 1989, requires DNR to ensure that the quality and quantity of Missouri's water resources are maintained at the highest

possible level to support present and future beneficial uses. The provision was established to provide for the development, maintenance, and periodic updating of a long-range comprehensive statewide plan for the use of surface water and groundwater. It includes existing and future requirements for drinking water supplies, agriculture, industry, recreation, and environmental protection, and related needs.

VI. SYNOPSIS

In addition to damage to crops, produce, livestock, and soil, and the resulting economic consequences, the arid conditions created by drought pose an increased risk of fire. The danger is especially high for brush fires, grass fires, and fires in wooded areas, which can threaten homes and other structures in their path. Lack of water resources in rural areas can complicate the firefighting efforts. During the spring 2000 drought, brush and wildfires erupted in numerous counties, resulting in a Governor's declared State of Emergency. The fires in Camden County were the most severe (See Fires, Annex I, in this State Hazard Analysis).

Severe drought also poses health threats to citizens due to water shortages and extreme heat. Particularly vulnerable are children, the elderly, and those with respiratory problems. Contaminated or poor water quality for drinking and sanitation measures can also cause serious illnesses. The Missouri Drought Response Plan addresses issues regarding water shortages and can be accessed via the DNR website: www.dnr.mo.gov.

VII. MAPS OR OTHER ATTACHMENTS PALMER DROUGHT SEVERITY INDEX: TABLE D-1

Palmer Drought Severity Index: Figure D-1

Drought Susceptibility: Figure D-2

Drought Condition Status, August 13, 2002: Figure D-3

Drought Condition Status, July 29, 2003: Figure D-4

Drought Condition Status, January 13, 2004: Figure D-5

Interim Drought Status, September 19, 2006: Figure D-6

U.S. Drought Monitor August 21, 2012: Figure D-7

U.S. Drought Monitor- Missouri , August 21, 2012: Figure D-8

FIGURE D-1

PALMER DROUGHT SEVERITY INDEX
Missouri Subregions

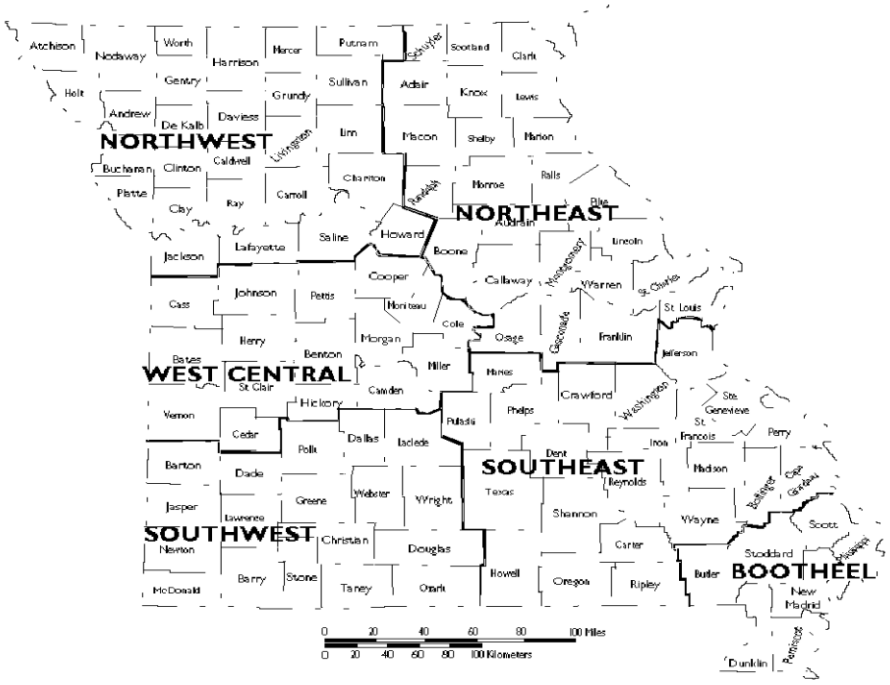
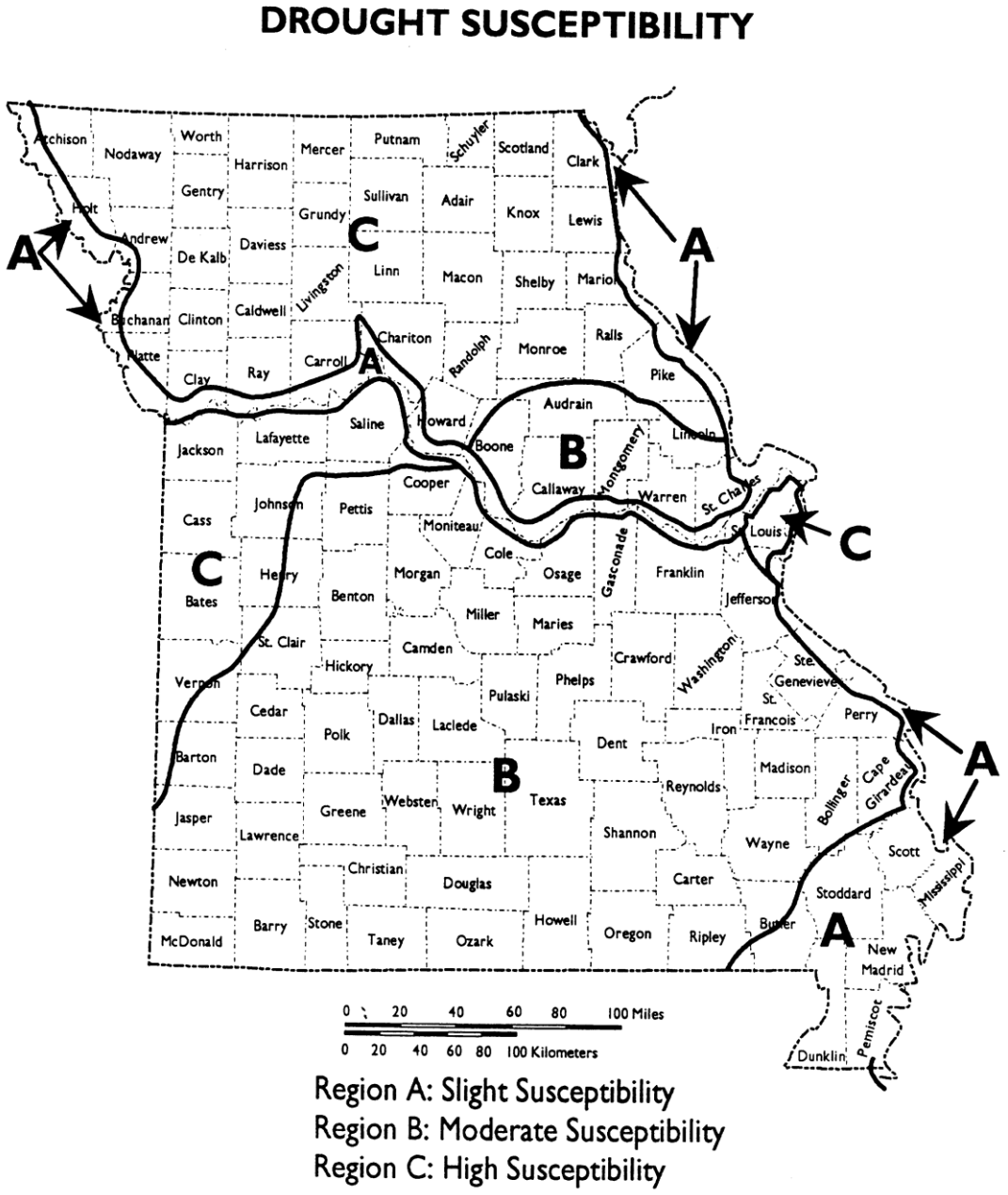
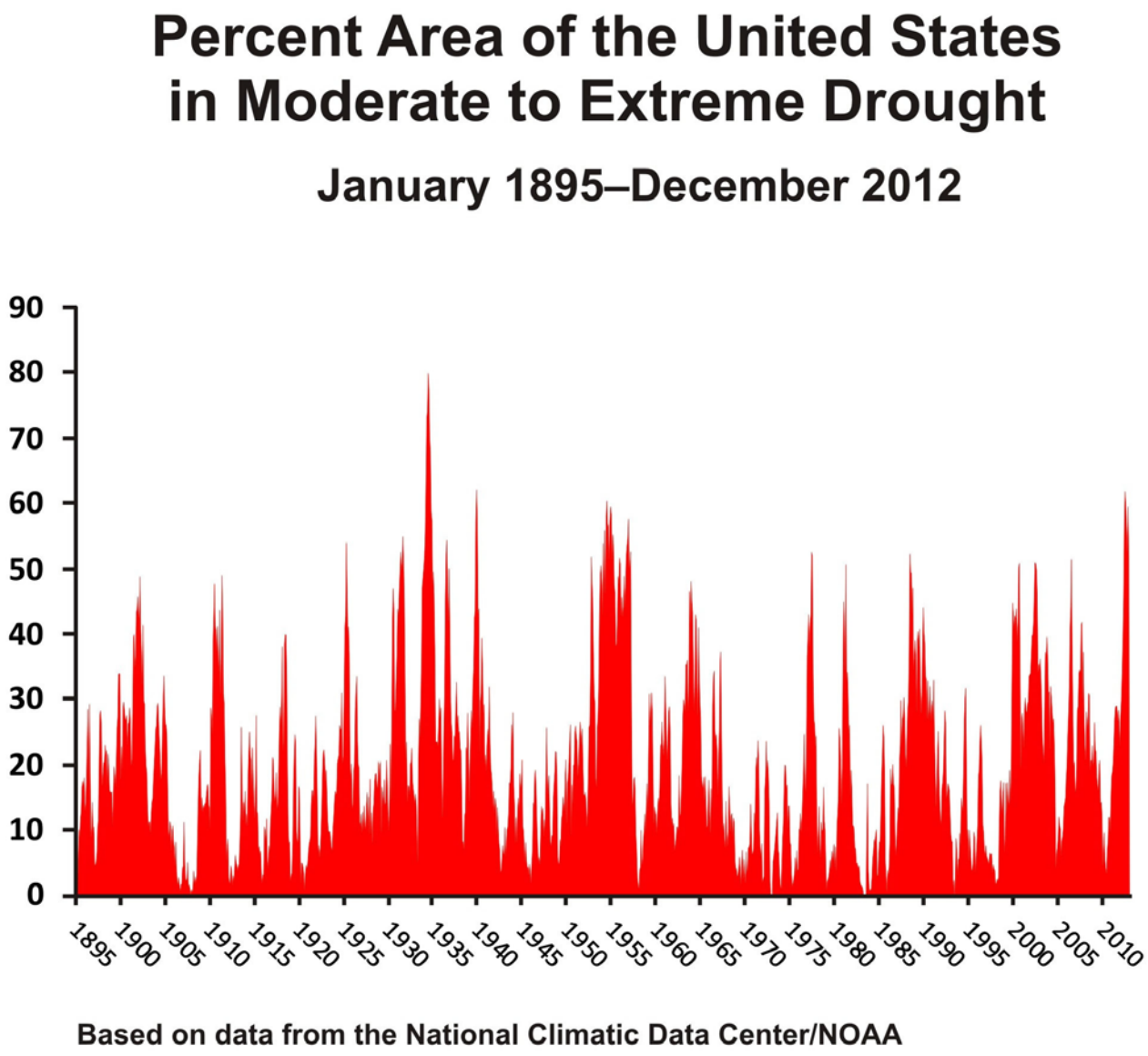


FIGURE D-2

DROUGHT SUSCEPTABILITY
MISSOURI DROUGHT RESPONSE PLAN





National Drought Mitigation Center “DROUGHTSCAPE”, Winter 2013

Figure D-3

Drought Condition Status (August 13, 2002)

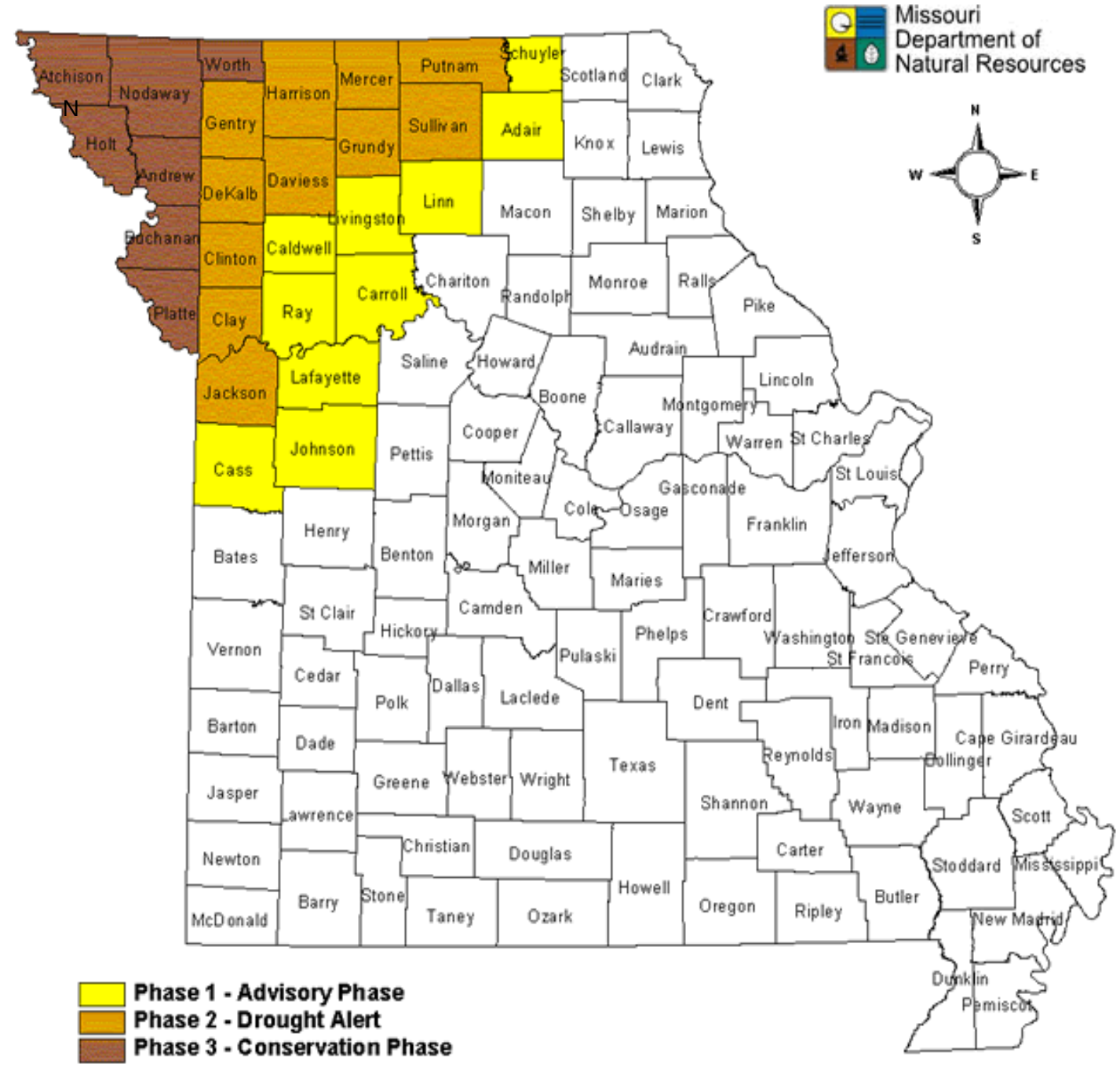


Figure D-4

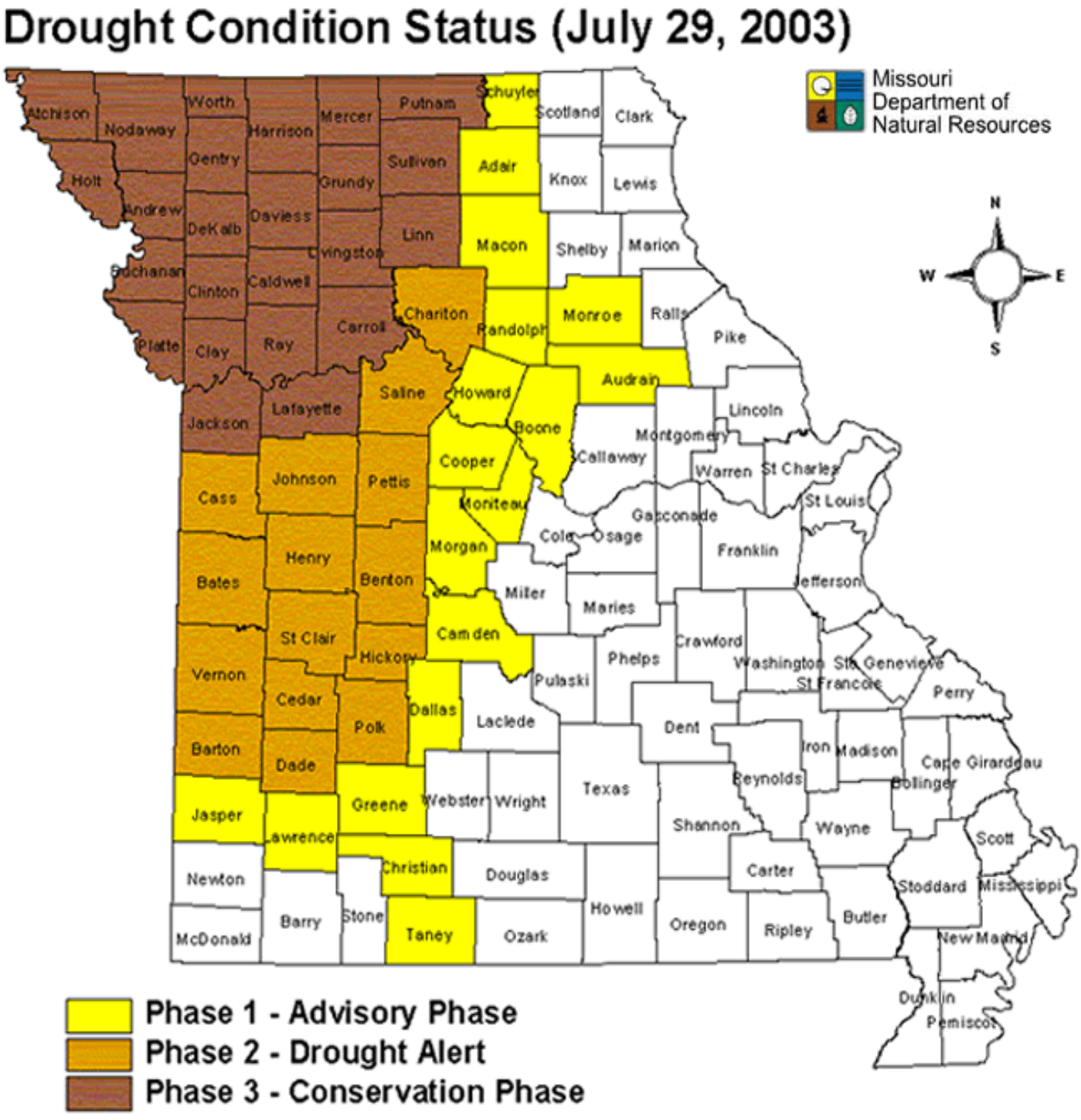


Figure D-5

Drought Condition Status (January 13, 2004)

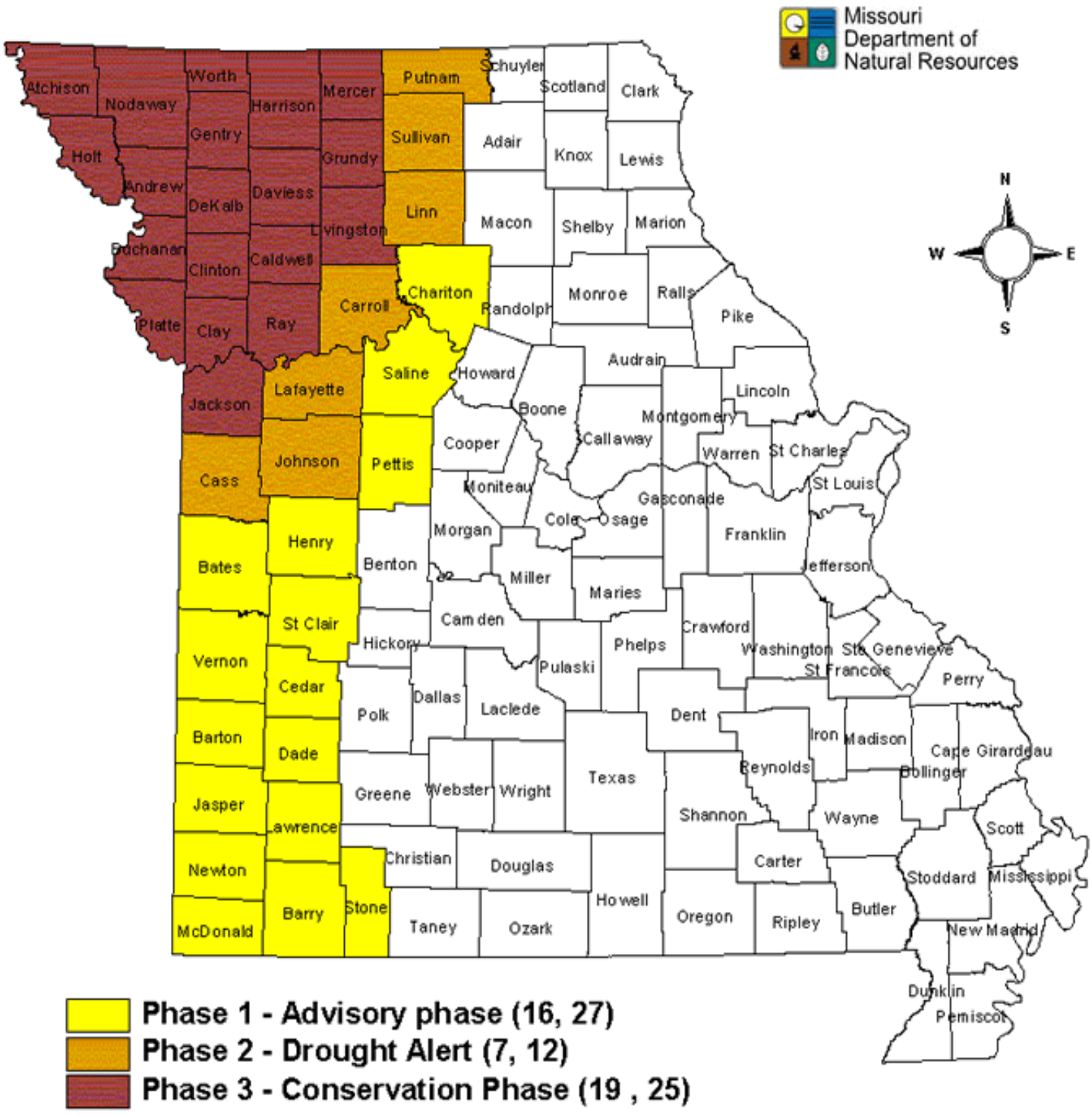


Figure D-6

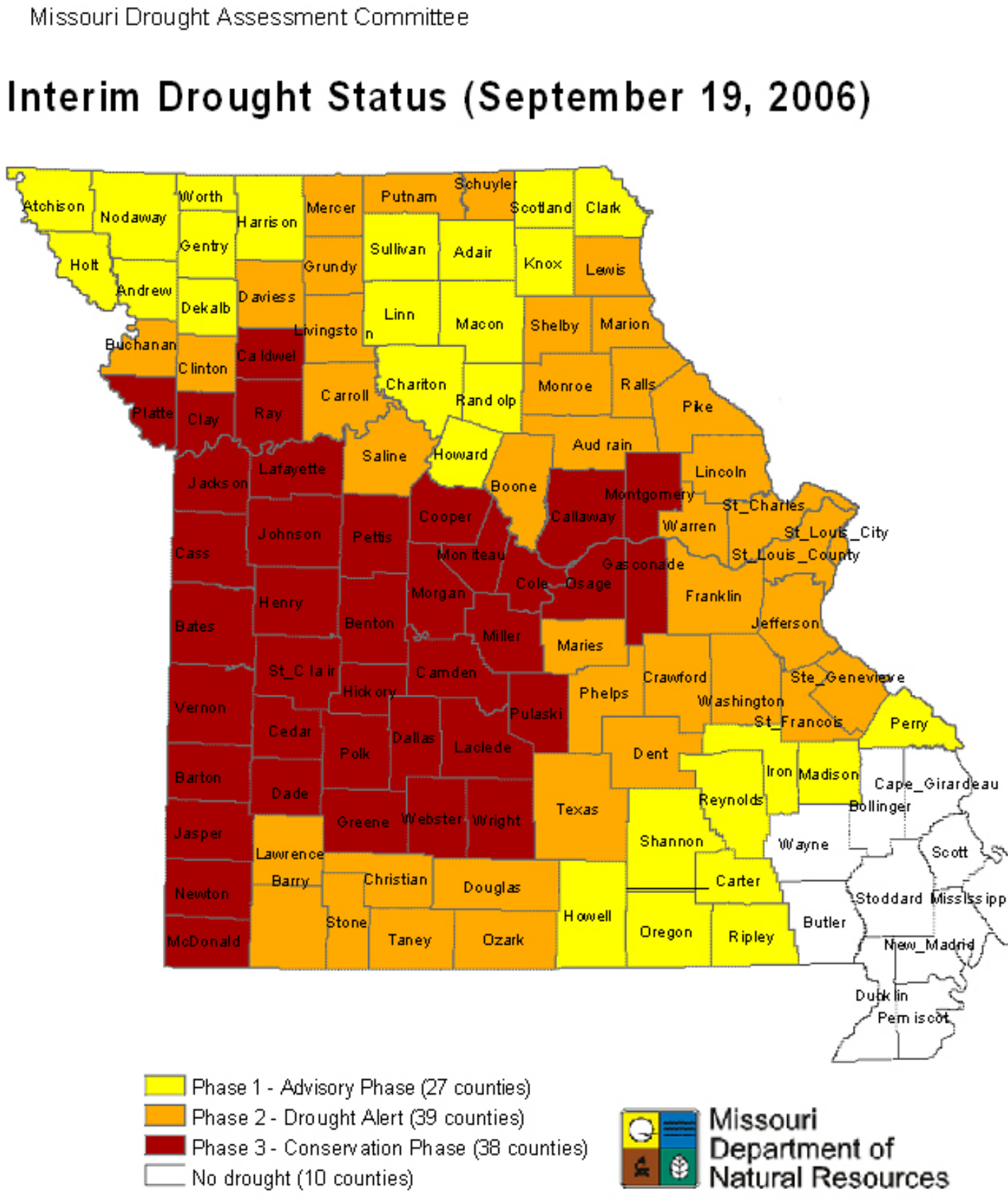

Missouri Drought Assessment Committee
Interim Drought Status (September 19, 2006)
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
Dekalb
Daviess
Livingston
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwel
Carroll
Chariton
Randolp
Monroe
Ralls
Pike
Platte
Clay
Ray
Saline
Howard
Audrain
Lincoln
Jackson
Lafayette
Boone
Montgomery
St_Charles
Cooper
Callaway
Warren
St_Louis_City
Cass
Johnson
Pettis
Moniteau
Gasconade
St_Louis_County
Henry
Morgan
Cole
Osage
Franklin
Bates
Benton
Miller
Maries
Jefferson
St_Clair
Camden
Crawford
Ste_Genevieve
Hickory
Phelps
Washington
Vernon
Pulaski
St_Francois
Perry
Cedar
Polk
Dallas
Laclede
Dent
Iron
Madison
Barton
Dade
Texas
Reynolds
Cape_Girardeau
Bollinger
Greene
Webster
Wright
Jasper
Shannon
Wayne
Scott
Lawrence
Barry
Christian
Douglas
Carter
Newton
Howell
Stoddard
Mississipp
Stone
Oregon
Butler
McDonald
Taney
Ozark
Ripley
New_Madrid
Dunklin
Pemiscot
Phase 1 - Advisory Phase (27 counties)
Phase 2 - Drought Alert (39 counties)
Phase 3 - Conservation Phase (38 counties)
No drought (10 counties)
Missouri Department of Natural Resources

FIGURE D-7 – US DROUGHT MONITOR FOR THE UNITED STATES

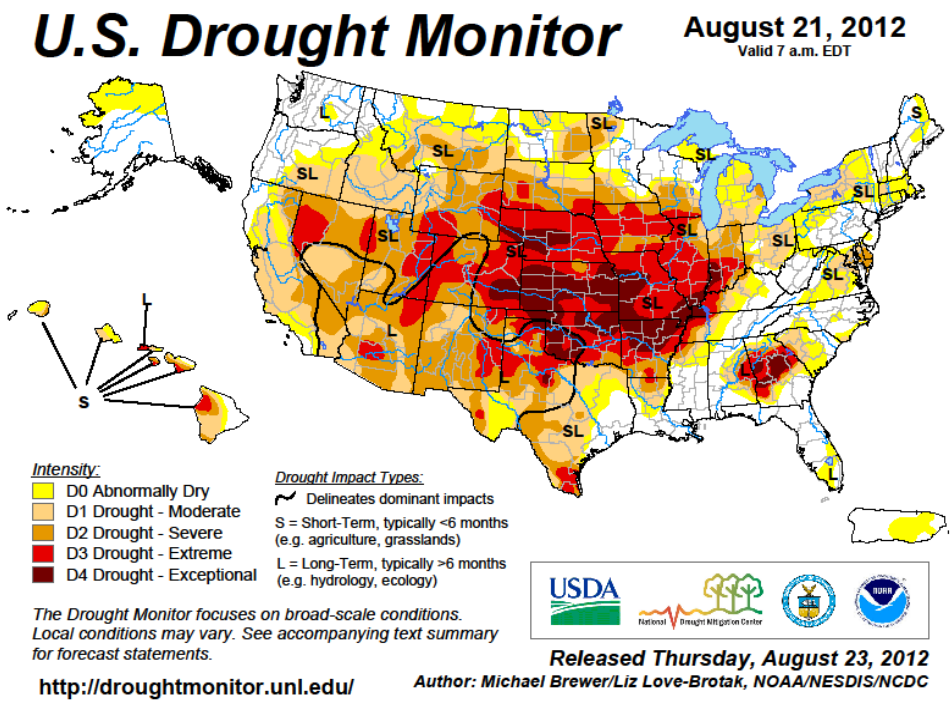
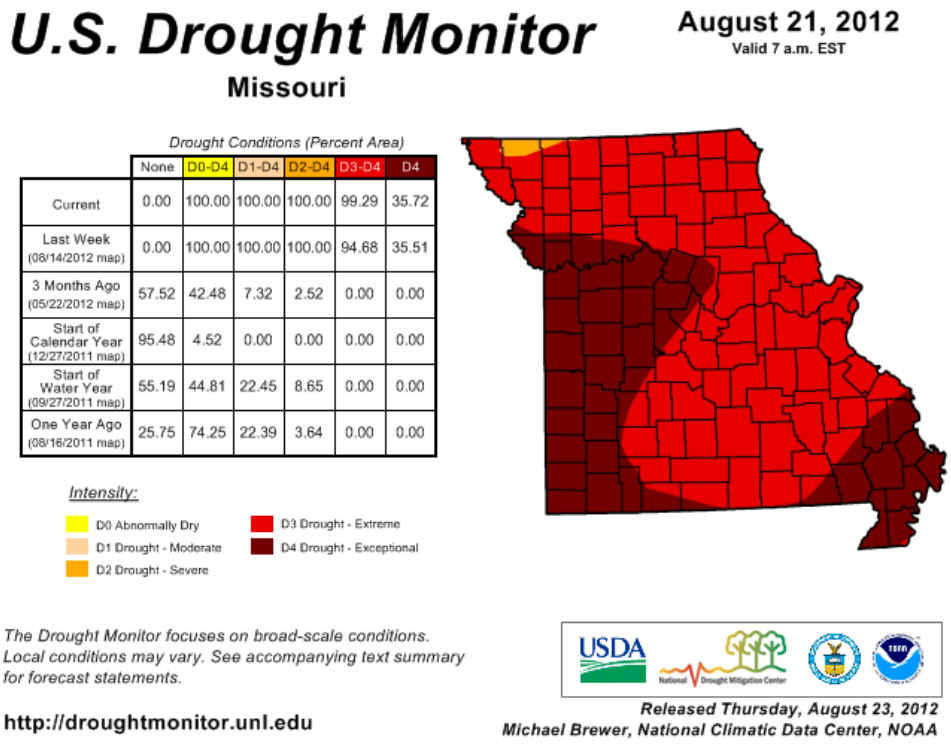
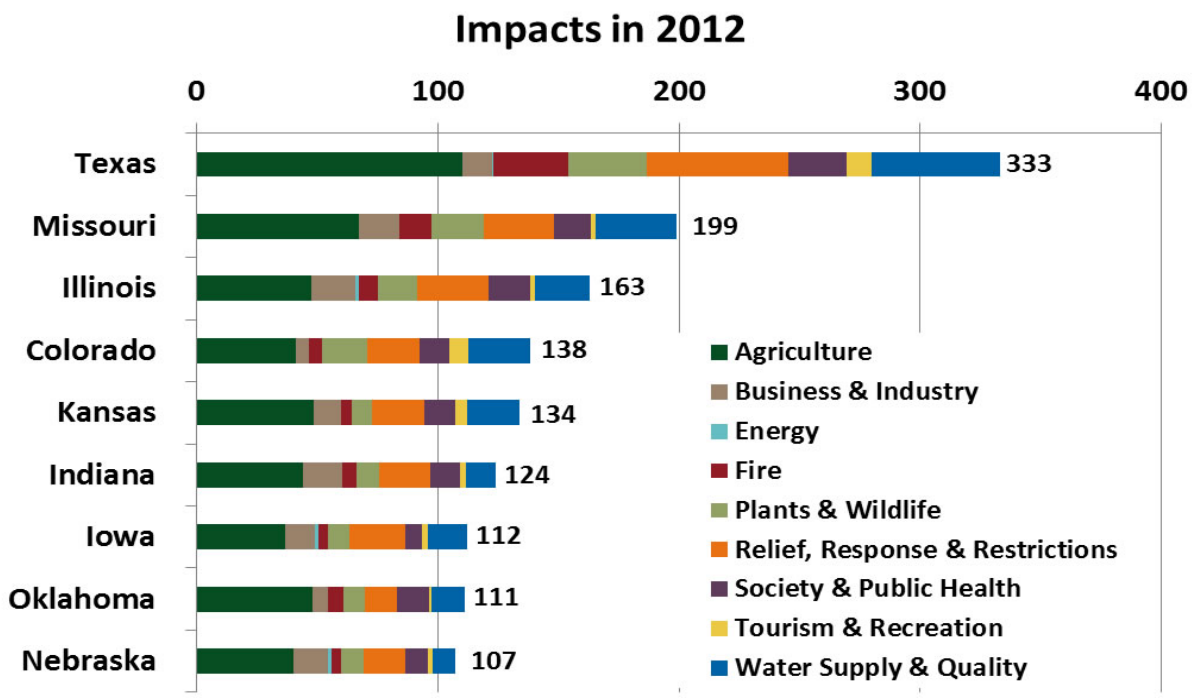


Figure D-8 US DROUGHT MONITOR FOR MISSOURI

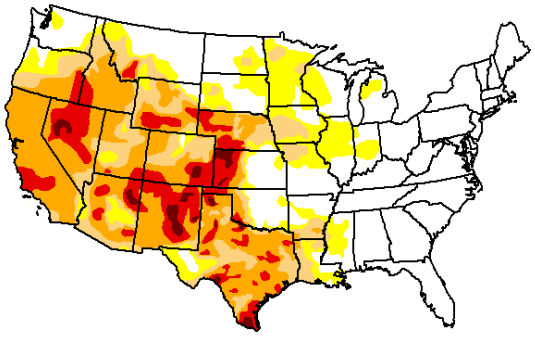




National Drought Mitigation Center “DROUGHTSCAPE”, Winter 2013

U.S. Drought Monitor

CONUS



August 20, 2013

(Released Thursday, Aug. 22, 2013)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	40.02	59.98	45.61	32.23	10.54	1.32
Last Week 8/13/2013	42.70	57.30	45.26	31.57	11.77	2.03
3 Months Ago 5/21/2013	39.06	60.94	46.07	31.16	12.64	4.94
Start of Calendar Year 1/1/2013	27.22	72.78	61.09	42.05	21.31	6.75
Start of Water Year 9/25/2012	23.41	76.59	65.45	42.12	21.48	6.12
One Year Ago 8/21/2012	22.72	77.28	63.20	44.03	23.01	6.31

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

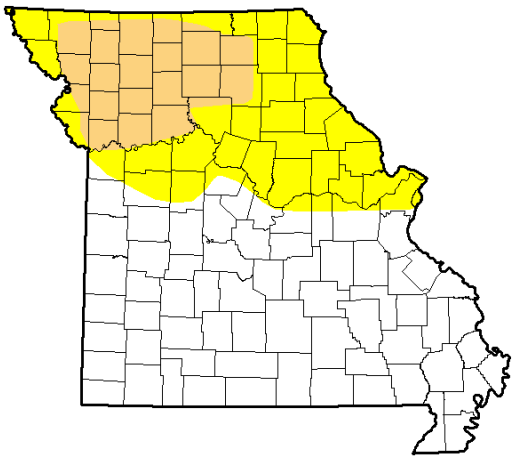
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author(s):
Michael Brewer
NCDC/NOAA

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

Missouri



August 20, 2013

(Released Thursday, Aug. 22, 2013)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	59.19	40.81	14.53	0.00	0.00	0.00
Last Week 8/13/2013	59.19	40.81	14.53	0.00	0.00	0.00
3 Months Ago 5/21/2013	94.31	5.69	2.70	0.00	0.00	0.00
Start of Calendar Year 1/1/2013	0.00	100.00	94.68	40.42	0.00	0.00
Start of Water Year 9/25/2012	0.00	100.00	100.00	84.50	16.90	0.00
One Year Ago 8/21/2012	0.00	100.00	100.00	100.00	99.29	35.72

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Michael Brewer
NCDC/NOAA

http://droughtmonitor.unl.edu/

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NDMC, "DROUGHTSCAPE" Winter 2013. http://drought.unl.edu/NewsOutreach/DroughtScape.aspx

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ANNEX E

HEAT WAVE

I. TYPE OF HAZARD

Heat Wave

II. DESCRIPTION OF HAZARD

A heat wave is a period of excessive heat, which can lead to illness and other stress to people with prolonged exposure to these conditions. High humidity, which often accompanies heat in Missouri, can make the effects of heat even more harmful. While heat-related illness and death can occur from exposure to intense heat in just one afternoon, heat stress on the body has a cumulative effect. Consequently, the persistence of a heat wave increases the threat to public health. These high temperatures generally occur from June through September, but are most prevalent in the months of July and August. Missouri experiences about 40 days per year above 90 °F, based on a 30-year average compiled by the NWS from 1971 through 2000. The month of July leads with a statewide mean with 15 days above 90 °F, followed by August with an average of 13 days over 90 F. June and September average 6 days and 4 days, respectively, for temperatures above 90 °F. The 30-year climatic data is from NWS stations at Kansas City, Columbia, Springfield, and St. Louis. As these regional locations indicate, all of Missouri is subject to heat wave during the summer months.

July 2006 was no exception to heat wave conditions in Missouri. On July 19, 2006, a severe thunderstorm complex moved across the St. Louis Metropolitan area downing thousands of trees and power lines. Local utility companies reported 750,000 customers lost electric service. The high temperature that day was 100 degrees. The high temperature the following day was 98. The maximum Heat Index both days was around 110 degrees. On July 21, 2006, another severe thunderstorm complex moved across the St. Louis area downing more trees and power lines. An additional 250,000 customers lost electric service. Many households and businesses were without power for over one week as high temperatures stayed it the middle to upper 90s with the Heat Index ranging from 105 to 115. By the end of July 10 heat related deaths have been reported in Jefferson County, St. Louis City, and St. Louis County. A Federal disaster declaration was received on July 21, 2006, for the City of St. Louis and surrounding counties to the west and southwest.

Along with humans, animals also can be affected by high temperatures and humidity. For instance, cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. The hotter the animal is, the more it will begin to shut down body processes not vital to its survival, such as milk production, reproduction, or muscle (meat) building.

Ambient temperature is not the only factor that should be considered when assessing the likely effects of heat. Relative humidity must also be considered, along with duration of exposure, wind, and activity. The NWS has stepped up its efforts to more effectively alert the general public and appropriate authorities to the hazards of heat waves–those prolonged episodes of

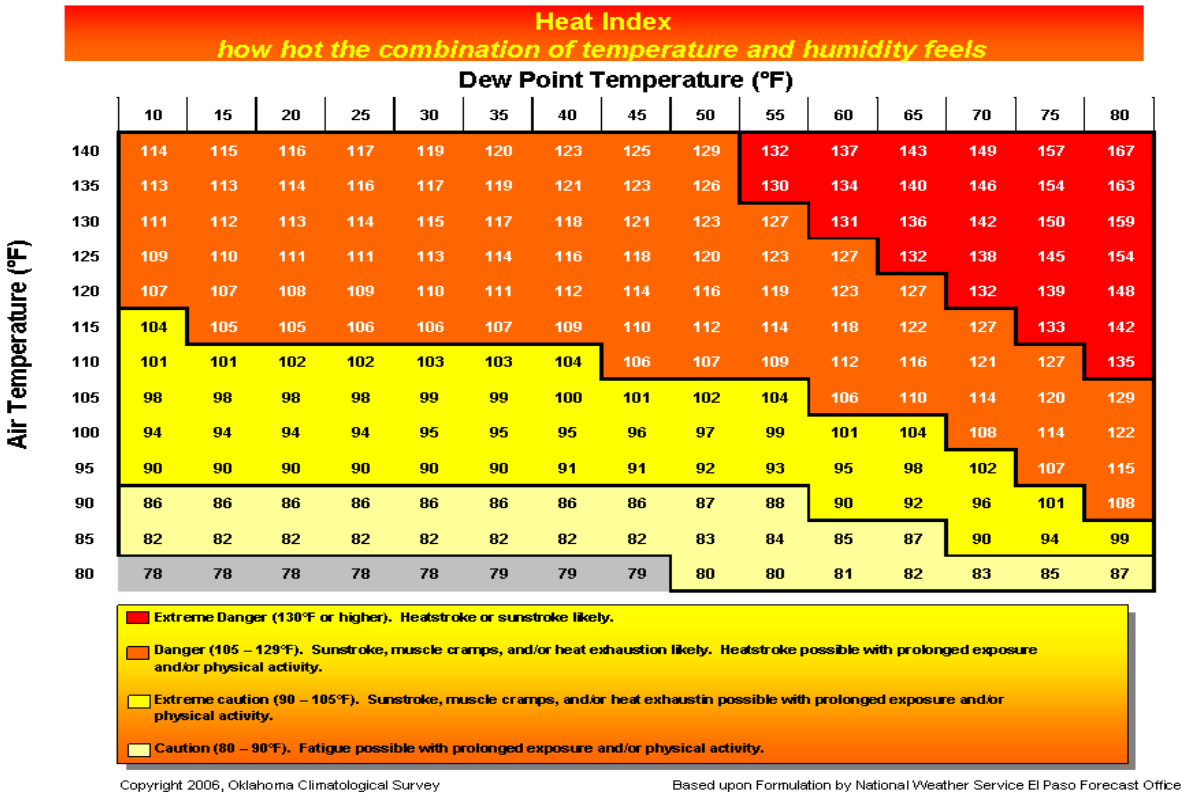
excessive heat and humidity. The NWS has devised a Heat Index (HI), which is a combination of air temperature and relative humidity, and more accurately reflects the heat intensity.

A. Heat Index Charts

The heat index (sometimes called the apparent temperature) is a measure of the contribution that high temperature and high humidity (expressed either as relative humidity (RH) or dew point temperature) make in reducing the body's ability to cool itself. The Heat Index calculator or tables below may be used to estimate the heat index. For example, with a temperature of 90° F and RH of 70% the heat index is 106° F or 41° C. The heat index (HI) is an accurate measure of how hot it really feels when the affects of humidity are added to high temperature.

When the heat index is between 90° F and 104° F sunstroke, heat cramps or heat exhaustion are possible with prolonged exposure and physical activity. When the index is between 105° F and 129° F sunstroke, heat cramps, or heat exhaustion is likely and heatstroke is possible. Heat indices of 130° or higher will result in heatstroke or sunstroke quickly.

To reduce the risk of the danger from high humidity and high temperature wear light and loose fitting clothing and a large hat. Stay in the shade as much as possible, avoid alcoholic beverages, and drink water frequently. It is usually best to perform strenuous outdoor activity early in the morning or during the evening hours when the heat index is expected to be relatively low.



NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Heat waves are often a major contributing factor to power outages (brownouts, etc.), as the high temperatures result in a tremendous demand for electricity for cooling purposes. Power outages for prolonged periods increase the risk of heat stroke and subsequent fatalities due to loss of cooling and proper ventilation.

Other related hazards include water shortages brought on by drought-like conditions and high demand. Local advisories, which list priorities for water use and rationing, are common during heat waves. Government authorities report that civil disturbances and riots are also more likely to occur during heat waves, as well as incidents of domestic violence and abuse.

III. HISTORICAL STATISTICS

Heat kills by taxing the human body beyond its abilities. In a normal year, approximately 175 Americans succumb to summer heat. In a 40-year period, 1936 through 1975, nearly 20,000 people died in the United States from the effects of heat and solar radiation. Over the past nine decades, the Missouri State Department of Health has compiled statistics for deaths from excessive heat. Figure E-2 in Section VII depicts the number of deaths in Missouri from 1911 to 2000. In 2001, it was reported that 47 Missourians died due to heat-related causes. In 2002, 24 persons died in Missouri due to heat. In United States, some of the worst years for heat-related deaths occurred during the Great Depression, with 843 deaths in 1934, and 644 in 1936. The worst year in the past few decades was 1980, with 1,250 deaths from excessive heat.

IV. MEASURE OF PROBABILITY AND SEVERITY

Based on 30-year statistics from the NWS indicating the state's mean number of days above 90 °F, Missouri is vulnerable to heat waves ranging from high to moderate risk in July and August.

The NWS has developed a Heat Index/Heat Disorder Chart that relates ranges of HI with specific disorders, particularly for people in higher risk groups (Table E-1).

TABLE E-1

Heat Index	Heat Disorder
130 °F or higher	Heat stroke or sunstroke likely with continued exposure
105 to 129 °F	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure or physical activity
90 to 104 ° F	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure or physical activity
80 to 89 °F	Fatigue possible with prolonged exposure or physical activity

NWS Excessive Heat Watch/Advisory/Warning criteria for Missouri are as follows:

Excessive Heat Watch: Issued 24 – 36 hours in advance when there is a good chance of Excessive Heat Warning Criteria being met.

Excessive Heat Advisory: The Heat Index (HI) will reach 105 degrees. Or, the HI is expected to range from 100 – 104 for at least 4 consecutive days.

Excessive Heat Warning: The HI will reach 110 degrees for 2 consecutive days. Or, the HI is expected to reach at least 105 degrees for at least 4 consecutive days.

V. IMPACT OF THE HAZARD

The severity of heat disorders tends to increase with age. Heat cramps in a 17-year-old can become heat exhaustion for someone in their forties, and may result in a fatal stroke for someone in their sixties. The following table lists conditions associated with heat, their symptoms and suggested first aid.

TABLE E-4

Heat Disorder	Symptoms	First Aid
Sunburn	Redness and pain. In severe cases, swelling of skin, blisters, fever, and headaches.	Apply ointment for mild cases if blisters appear. If breaking occurs, apply dry sterile dressing. Serious, extensive cases should be seen by physician.
Heat Cramps	Painful spasms possible usually in muscles of legs and abdomen. Heavy sweating.	Apply firm pressure on cramping muscles, or gentle massage to relive spasms. Give sips of water.
Heat Exhaustion	Heavy sweating and weakness; cold, pale and clammy skin. Pulse thready. Normal temperature possible. Fainting and vomiting.	Get victim out of sun. Lie down and loosen clothing. Apply cool wet cloths. Fan or move victim to air conditioned room. Give sips of water. If vomiting continues, seek immediate medical attention.
Heat Stroke (or Sunstroke)	High body temperature (106 °F, or higher). Hot dry skin. Rapid and strong pulse. Possible unconsciousness.	Heat stroke is a severe medical emergency. Summon medical assistance or get the victim to a hospital immediately. Delay can be fatal. Move the victim to cooler environment. Reduce body temperature with cold bath or sponging. Use extreme caution. Remove clothing. Use fans and air conditioners. If temperature rises again, repeat process. Do not give fluids.

The following population groups are at a greater risk to becoming very sick from heat waves:

A. Those Vulnerable To Heat Stress Due To Physical Condition

1. Older people
2. Children
3. People overweight or underweight

B. People with Limited Independence Due to Physical or Mental Disorders

1. People in institutional settings without air conditioning
2. People working in heat under stress (firefighters, police, emergency medical technicians, etc…)
3. People in urban environments where heat retention in asphalt, concrete and masonry is a factor (heat island effect)
4. People with low income who lack resources for air conditioning, transportation, medical care, etc…

C. Those with Increased Risk from Work or Leisure Activities

1. People who work outdoors (utility crews, construction crews, etc…)
2. Military personnel and trainees
3. Athletes

D. Those More Difficult to Reach Through Normal Communications

1. People who live alone
2. People who are homeless
3. People who do not speak English
4. People who cannot read
5. People who are culturally, socially, or geographically isolated

Even when the heat injury is not fatal, it can be extremely serious and require lifelong monitoring of further exposure to heat. Besides mortality statistics due to heat, the Missouri Department of Health and Senior Services also track's heat-related injuries. Figure E-3 in Section VII shows heat-related illnesses in Missouri from 1991 through 2000.

As previously mentioned, animals can be adversely affected by heat stress. This poses a risk to farmers, ranchers, and the entire State of Missouri, which relies on agricultural revenue to keep the economy strong. Livestock producers cannot afford to ignore the effects of high temperatures on their herds. The following symptoms are signs of heat stress on livestock:

- Restlessness and crowding under shade or at water tanks/areas
- Open-mouthed breathing or panting and increased salivating

- Increased respiration rates
- Gasping and lethargic demeanor.

VI. SYNOPSIS

Many people do not realize how deadly a heat wave can be. In contrast to the visible, destructive, and violent nature of floods, hurricanes, and tornadoes, a heat wave is a "silent killer." Be aware of the warning signs of heat-related illness, such as light-headedness, mild nausea or confusion, sleepiness, or profuse sweating. To prevent heat-related illness, take the following precautions:

- Increase your fluid intake; drink more liquids than your thirst indicates
- Drink nonalcoholic and caffeine-free liquids, such as water and juices
- Wear lightweight, light colored, loose-fitting clothing
- When unaccustomed to working or exercising in a hot environment, start slowly and pick up the pace gradually; rest frequently in a shady area
- Spend time in an air-conditioned place; if not at home, then spend time in such public places as libraries, supermarkets, shopping malls, and movie theatres
- Do not rely on fans as your primary cooling devices during a heat wave
- Schedule outdoor activities carefully, preferably before noon or in the evening
- When working in the heat, monitor the condition of your co-workers and have someone do the same for you
- Monitor those at high risk, such as the elderly, infants, and children up to 4 years of age, someone who is overweight, or someone on medication
- Ask your physician whether you are at particular risk because of medication
- Do not leave infants, children, or pets unattended in a parked car or other hot environments

Although fans are less inexpensive to operate, they may not be effective, and may even be harmful when temperatures are very high. As the air temperature rises, airflow is increasingly ineffective in cooling the body until finally, at temperatures above 100 °F (the exact number varies with the humidity), increasing air movement actually increases heat stress. More specifically, when the temperature of the air rises to about 100 °F, the fan may be delivering overheated air to the skin at a rate that exceeds the capacity of the body to get rid of this heat, even with sweating, and the net effect is to add heat rather than to cool the body. An air conditioner, if one is available, is a much better alternative. More information on heat-related illness is available through the Department of Health's web page: www.dhss.mo.gov\hyperthermia.

VII. MAPS OR OTHER ATTACHMENTS

Attached are the Missouri Department of Health statistics for heat-related illnesses and deaths.

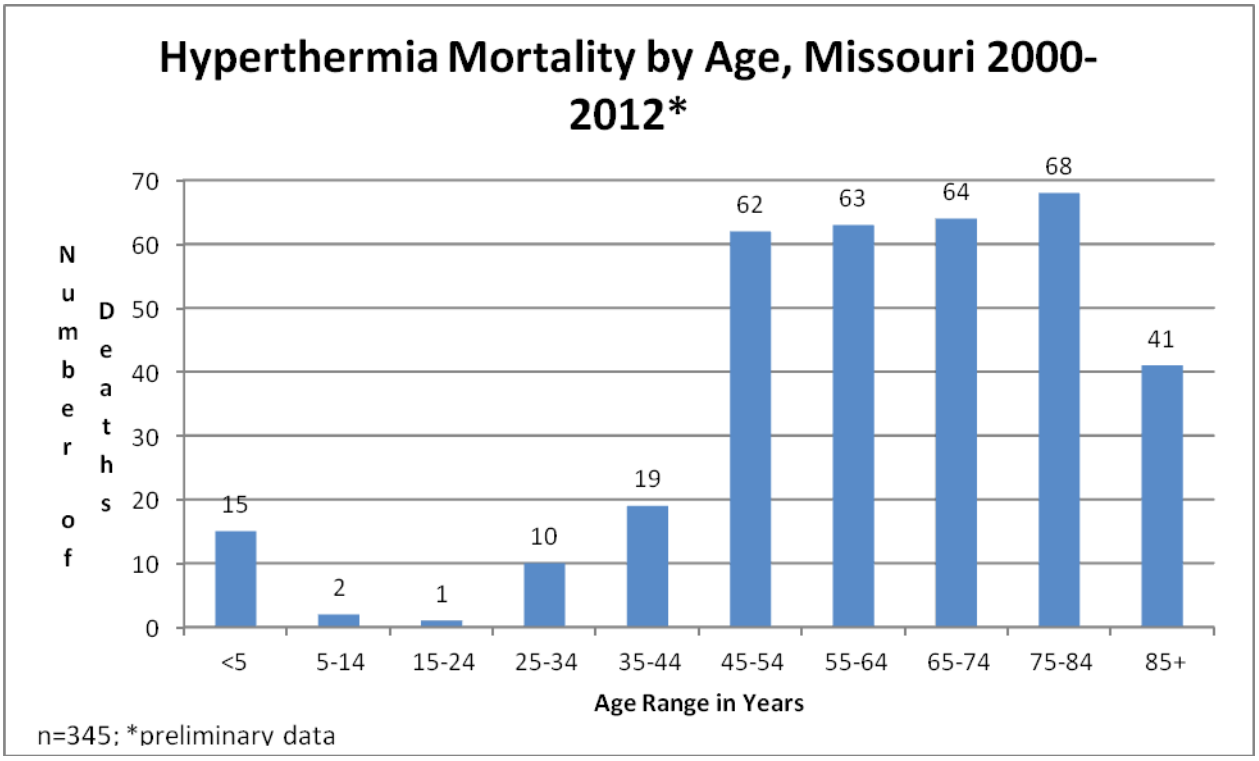
- Heat-Related Death Chart: Figure E-2
- Number of Heat-Related Illnesses in Missouri in 1991-2000: Figure E-3

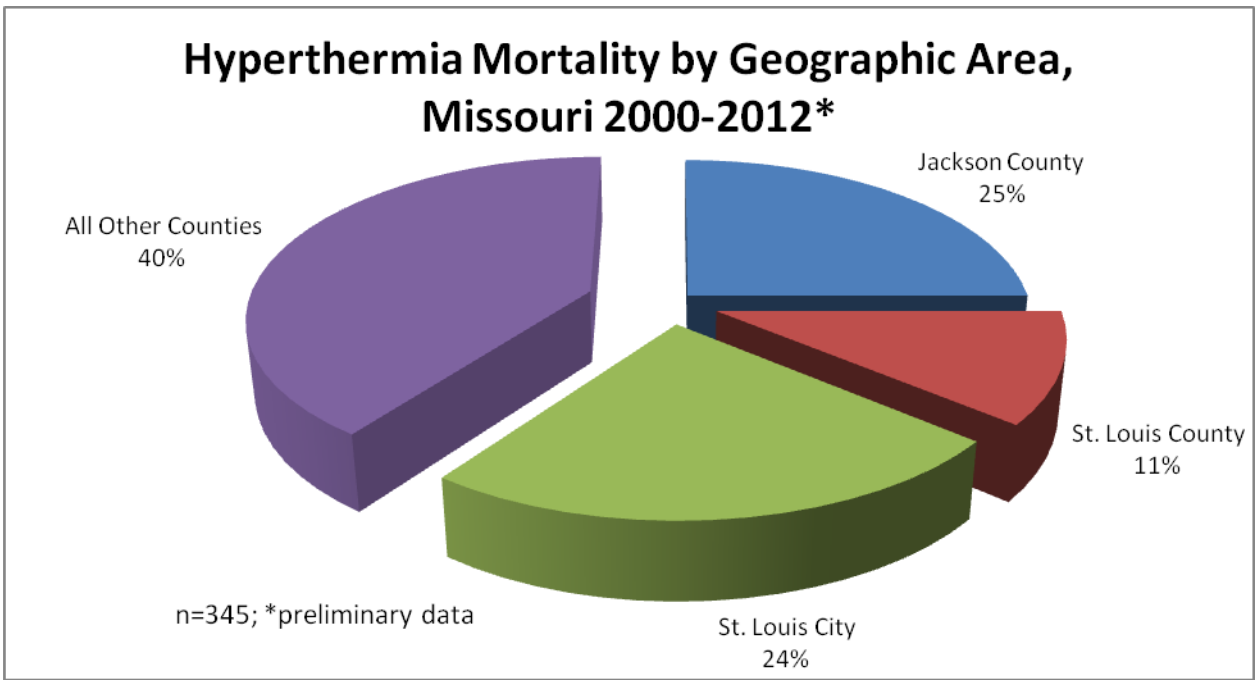
Missouri Heat Related Deaths*

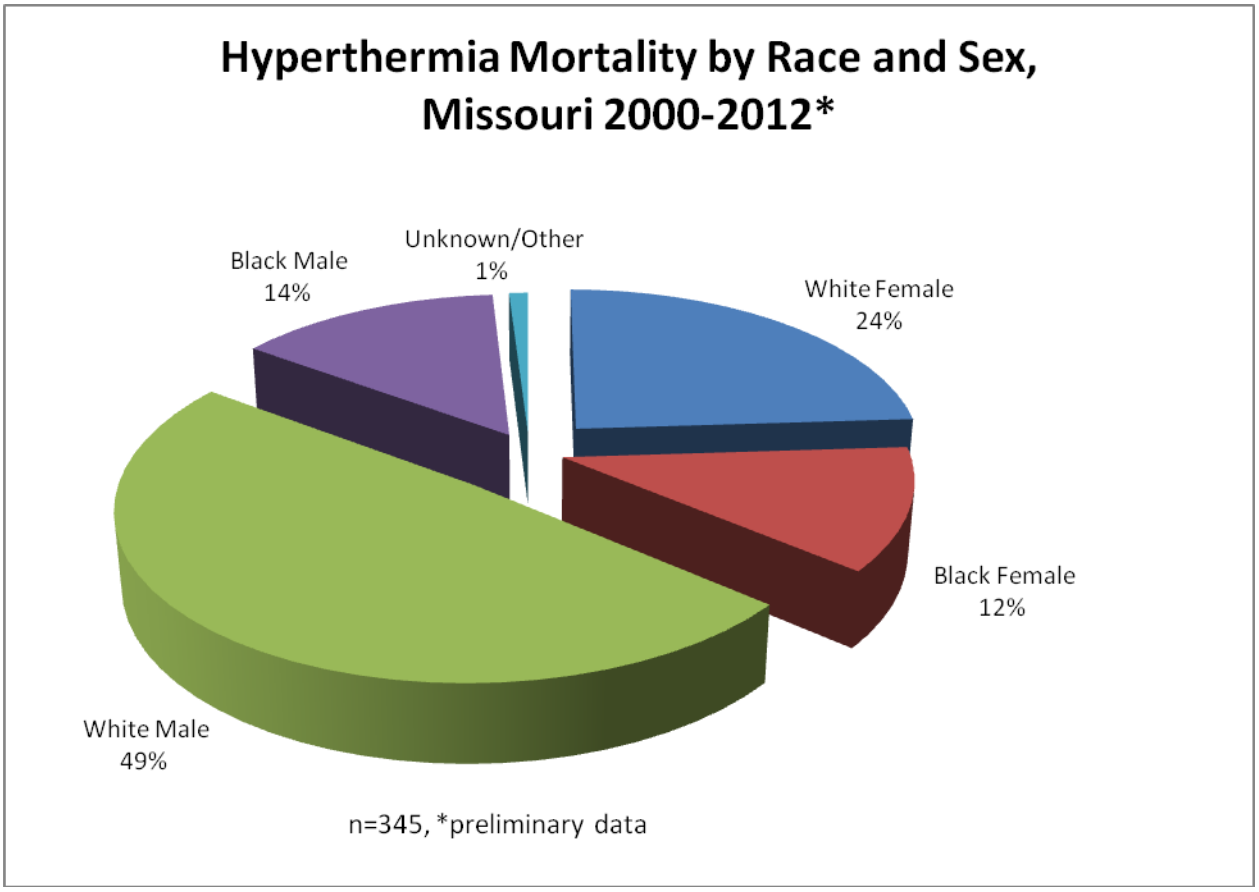
Year	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997
Deaths	52	47	17	11	10	34	25	25	3	14	24	47	23	92	12	9

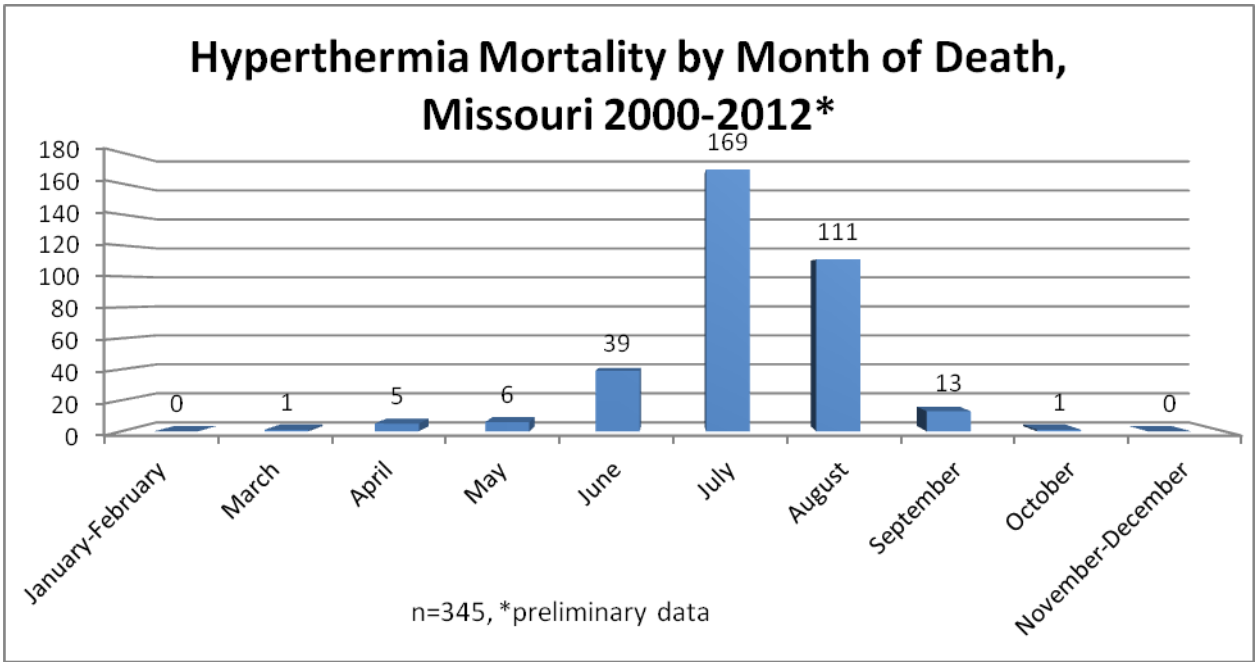
Missouri Heat Related Deaths: 1980 - 2012: 1048

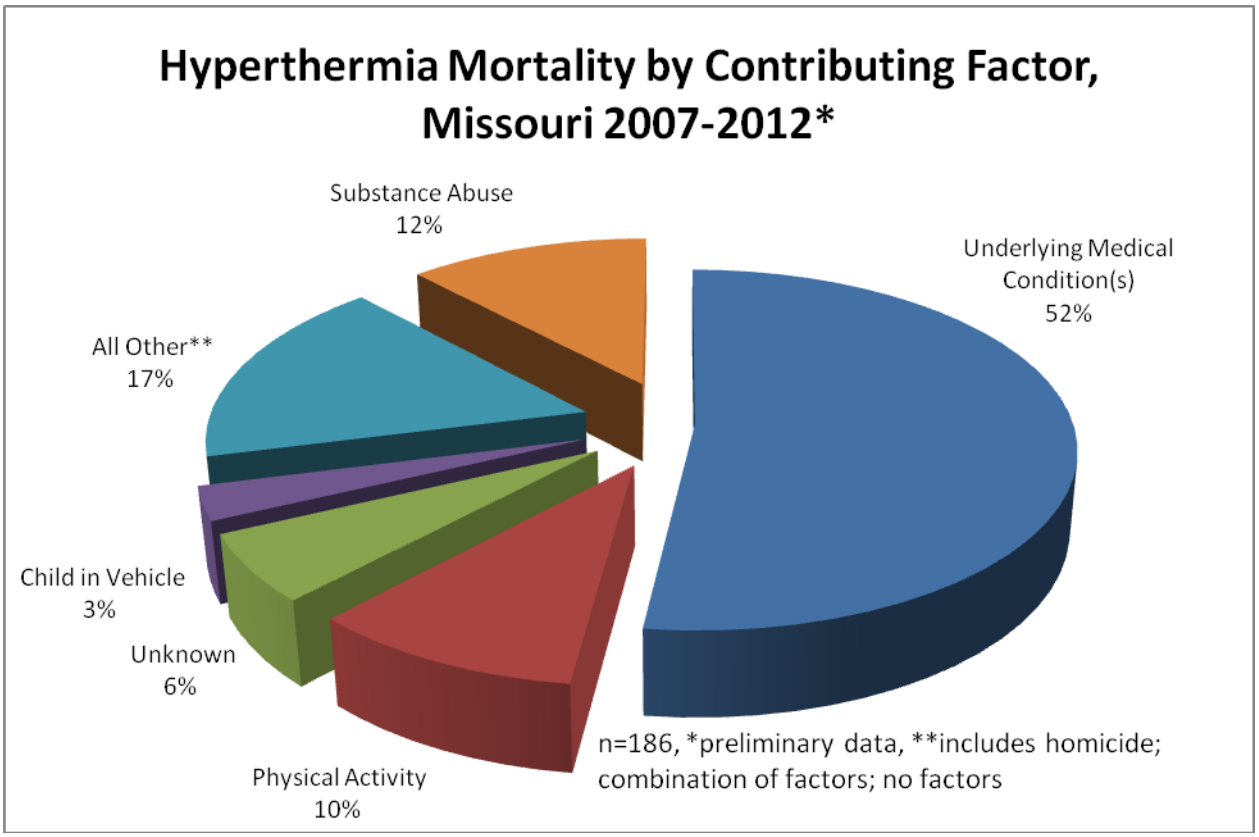
Missouri Heat Related Deaths: 1995 - 2012: 508




Hyperthermia Mortality by Geographic Area, Missouri 2000-2012*
Jackson County 25%
All Other Counties 40%
St. Louis County 11%
St. Louis City 24%
n=345; *preliminary data


Hyperthermia Mortality by Race and Sex, Missouri 2000-2012*
Black Male 14%
Unknown/Other 1%
White Female 24%
Black Female 12%
White Male 49%
n=345, *preliminary data


Hyperthermia Mortality by Month of Death, Missouri 2000-2012*
180
160
140
120
100
80
60
40
20
0
0
1
5
6
39
169
111
13
1
0
January-February
March
April
May
June
July
August
September
October
November-December
n=345, *preliminary data


Hyperthermia Mortality by Contributing Factor, Missouri 2007-2012*
Substance Abuse 12%
Underlying Medical Condition(s) 52%
All Other** 17%
Child in Vehicle 3%
Unknown 6%
Physical Activity 10%
n=186, *preliminary data, **includes homicide; combination of factors; no factors

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ANNEX F

EARTHQUAKES

I. TYPE OF HAZARD

Earthquakes

II. DESCRIPTION OF HAZARD

Earthquakes are defined as shifts in the earth's crust causing the surface to become unstable. This instability can manifest itself in intensity from slight tremors to large shocks. The duration can be from a few seconds up to 5 minutes. The period of tremors (and shocks) can last up to several months. The larger shocks can cause ground failure, landslides, liquefaction, uplifts, and sand blows.

The earth's crust is made up of gigantic plates, commonly referred to as tectonic plates. These plates form what is know as the lithosphere, which varies in thickness from 6.5 miles (beneath oceans) to 40 miles (beneath mountain ranges), and has an average thickness of 20 miles. These plates "float" over a partly melted layer of crust called the asthenosphere. The plates are in motion, and areas where one plate joins another are referred to as “plate boundaries.” Areas where the plates are moving toward each other are called convergent plate boundaries, and areas when they are moving away from each other are called divergent plate boundaries. The San Andreas Fault in California is a horizontal motion boundary, where the Pacific plate is moving to the north while the North American plate is moving to the west. These movements release built-up energy in the form of earthquakes, tremors, and volcanic activity. Fault lines such as the San Andreas come all the way to the surface and can be readily seen and identified. Some fault lines do not come all the way to the surface, yet they can store and release energy when they move. Many of the faults in the central United States are characterized this way.

The subterranean faults were formed many millions of years ago on or near the surface of the earth. Subsequent to that time, these ancient faults subsided, while the adjacent areas were pushed up. As this fault zone (also known as a rift) lowered, sediments filled in the lower areas. Under pressure, sediments hardened into limestones, sandstones, and shales, thus burying the rifts. With the pressure on the North Atlantic ridge affecting the eastern side of the North American plate, and the movements along the San Andreas Fault by the Pacific plate, the buried rift system, in the Mississippi embayment has been reactivated. This particular rift system is now called the Reelfoot Rift.

Eight earthquake seismic zones are located in the central United States, two of which are located within the State of Missouri. The most active zone is the New Madrid Seismic Zone, which runs from northern Arkansas through southeast Missouri and western Tennessee and Kentucky to the Illinois side of the Ohio River Valley. Other zones, because of their close proximity, also affect Missourians. These are the Wabash Valley Seismic Zone, Illinois Basin, and the Nemaha Uplift.

The Nemaha Uplift is of concern to Missourians because it runs parallel to the Missouri/Kansas border from Lincoln, Nebraska, to Oklahoma City, Oklahoma. Earthquakes from the Nemaha Uplift are not as severe as those associated with the historic New Madrid seismic zone; several earthquakes have affected Missouri in the past. A 5.1 magnitude earthquake near Manhattan, KS in 1867 caused minor damage as far east as Chillicothe, MO.

III. HISTORICAL STATISTICS

The most severe earthquakes occurred in the New Madrid seismic zone during a period between December 16, 1811, and March 12, 1812. An engineer in Louisville, Kentucky, counted over 1,850 shocks during this time, including three earthquakes estimated to have magnitudes of 7.7 (U.S. Geological Survey, 2011). The shocks from these earthquakes could be easily felt as far away as Detroit, Michigan, and Charleston, South Carolina. The area between the St. Francois River and Mississippi River south of New Madrid to Marked Tree, Arkansas, showed numerous sand blows. A sand blow is a place where liquefacted alluvial soil has geysered out of the surface. Liquefaction is a phenomenon where the shaking of the ground separates the water from the soil holding it, causing the soil to behave like a dense liquid. The lack of water causes the soil to lose surface cohesion, and sand from these blows accumulates to a depth of up to 5 feet in places. Liquefaction causes land to lose its load-bearing capacity.

Areas uplifted as well as subsided (dropped) along the Mississippi River. For instance, the area around Tiptonville, Tennessee, formed a dome (uplift of several yards). Immediately adjacent to the Tiptonville Dome, an area subsided to form a lake 18 miles long and 5 miles wide. It is now known as Reelfoot Lake and is a tourist and recreation area. Ground failure and landslides were apparent throughout the bluffs (Chickasaw Bluffs) alongside the Mississippi River in Kentucky and Tennessee. Many fissures were made throughout the region, and one local observer recorded that the earth seemed to be rolling in waves a few feet in height. These swells would burst, leaving wide and long fissures. The damage to the area was so severe that Congress passed, and President James Madison signed into law, the first disaster relief act, giving government lands in other territories to people wanting to move out of the area.

In recent years along the Nemaha Ridge, two small earthquakes have occurred near the Cooper Nuclear Station in southeast Nebraska near Brownville. One was a 3.1 magnitude event on March 31, 1993 and the other was a 3.6 magnitude earthquake on December 16, 2009. Another 3.1 occurred March 23, 2007, near Effingham, Kansas. No damages resulted from any event; however the earthquakes were felt across the Missouri River into northwest Missouri.

IV. MEASURE OF PROBABILITY AND SEVERITY

The Center for Earthquake Research and Information (CERI) at the University of Memphis has computed conditional probabilities of a magnitude 6.0 earthquake in the New Madrid seismic zone. According to a fact sheet prepared by State Emergency Management Agency (SEMA) in 2003, the probability for a magnitude 6.0 to 7.5 or greater earthquake along the New Madrid Seismic Zone is 25 to 40 percent over the next 50 years. With approximately 12.5 million people living in the area, steps are being taken to reduce related hazards to citizens and property in the area. The probability of an earthquake increases with each day, which makes it difficult to rate. Based on the information from CERI, the probability of an earthquake is rated as moderate, and the severity is rated as high.

V. IMPACT OF THE HAZARD

The impacts of earthquakes on Missouri can be significant. The three New Madrid earthquakes of 1811-1812 may be the largest that have happened on the North American continent. Although losses were limited because of the sparse population of the time, many Native Americans died and property was damaged to the point that resettlement became a national policy.

Several studies indicate the need to prepare for earthquakes, as scholars estimate that the New Madrid Seismic Zone has the capability of generating Mercalli intensities of X (ten) in Southeast Missouri. The

late Dr. Otto Nuttli of St. Louis University stated in his book, "The Effects of Earthquakes in the Central United States," that surface-wave magnitudes of 7.6 (Richter) would create the largest possible earthquake that could occur anywhere along the New Madrid Seismic Zone in the near future. Information on preparedness and predictions related to the New Madrid Seismic Zone is provided on the U. S. Geological Survey Earthquake Hazards Program website: www.usgs.gov/hazards, and the Center for Earthquake Research and Information website: www.ceri.memphis.edu/usgs.

VI. SYNOPSIS

The chances of an earthquake increase each day. Energy from the movement of the North American tectonic plate continues to build up along both the New Madrid and Nemaha Seismic Zones and their subsidiary systems. The state will have an earthquake. We don't know exactly where or when, but we are overdue for a moderate earthquake. The earthquakes may affect the citizens of Missouri and surrounding states. Earthquakes also have secondary effects such as fires, building collapses, utility disruptions, flooding, hazardous materials releases, environmental impacts, and economic disruptions or losses.

VII. MAPS OR OTHER ATTACHMENTS

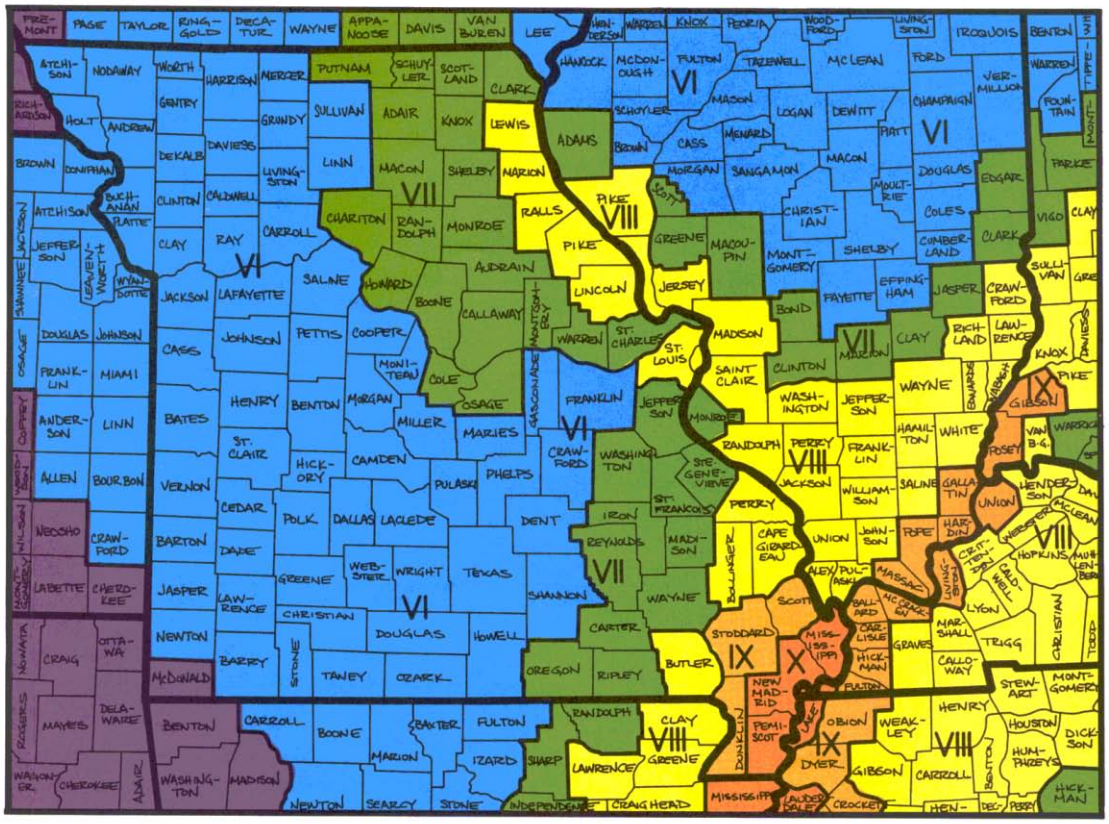
The attached figure shows the projected Modified Mercalli earthquake intensities by county expected from a 7.6 Richter magnitude earthquake along the New Madrid Seismic Zone. The secondary maps show the same relative intensities for these statewide regions for a 6.7 and an 8.6 Richter magnitude earthquake, respectively. The Modified Mercalli Intensity Scale descriptions are included following the maps in the figure. The intensity is a numerical index scale to describe the effects of an earthquake on the surface of the Earth, on man, and on man-made structures. Further discussion on this is included following the scale legend.

- Projected Earthquake Intensities: Figure F-1
- Moderate/Large Earthquakes in the Central United States.

FIGURE F-1

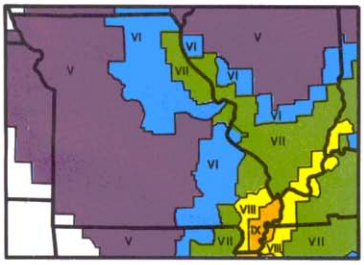
PROJECTED EARTHQUAKE INTENSITIES

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone. The secondary maps show the same regional intensities for a 6.7 and an 8.6 earthquake, respectively. For a description of Projected Earthquake Intensities V through X, see the page following the maps.



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

6.7



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

7.6

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

8.6

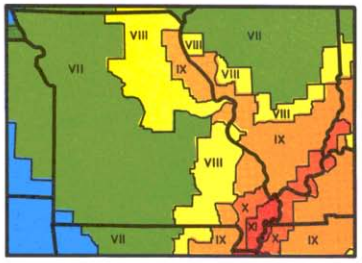


FIGURE F-1 (Continued)

PROJECTED EARTHQUAKE INTENSITIES

MODIFIED MERCALLI INTENSITY SCALE

I People do not feel any Earth movement.

II A few people might notice movement.

III Many people indoors feel movement. Hanging objects swing.

IV Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open vessels are slightly disturbed. Parked cars rock.

V Almost everyone feels movement. Most people are awakened. Doors swing open or closed. Dishes are broken. Pictures on the wall move. Windows crack in some cases. Small objects move or are turned over. Liquids might spill out of open containers.

VI Everyone feels movement. Poorly built buildings are damaged slightly. Considerable quantities of dishes and glassware, and some windows are broken. People have trouble walking. Pictures fall off walls. Objects fall from shelves. Plaster in walls might crack. Some furniture is overturned. Small bells in churches, chapels and schools ring.

VII People have difficulty standing. Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, spires and others. Damage is slight to moderate in well-built buildings. Numerous windows are broken. Weak chimneys break at roof lines. Cornices from towers and high buildings fall. Loose bricks fall from buildings. Heavy furniture is overturned and damaged. Some sand and gravel stream banks cave in.

VIII Drivers have trouble steering. Poorly built structures suffer severe damage. Ordinary substantial buildings partially collapse. Damage slight in structures especially built to withstand earthquakes. Tree branches break. Houses not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Temporary or permanent changes in springs and wells. Sand and mud is ejected in small amounts.

IX Most buildings suffer damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks conspicuously. Reservoirs suffer severe damage.

X Well-built wooden structures are severely damaged and some destroyed. Most masonry and frame structures are destroyed, including their foundations. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. Railroad tracks are bent slightly. Cracks are opened in cement pavements and asphalt road surfaces.

XI Few if any masonry structures remain standing. Large, well-built bridges are destroyed. Wood frame structures are severely damaged, especially near epicenters. Buried pipelines are rendered completely useless. Railroad tracks are badly bent. Water mixed with sand, and mud is ejected in large amounts.

XII Damage is total, and nearly all works of construction are damaged greatly or destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move. Lakes are dammed, waterfalls formed and rivers are deflected.

Intensity is a numerical index describing the effects of an earthquake on the surface of the Earth, on man, and on structures built by man. The intensities shown in these maps are the highest likely under the most adverse geologic conditions. There will actually be a range in intensities within any small area such as a town or county, with the highest intensity generally occurring at only a few sites. Earthquakes of all three magnitudes represented in these maps occurred during the 1811 - 1812 "New Madrid earthquakes." The isoseismal patterns shown here, however, were simulated based on actual patterns of somewhat smaller but damaging earthquakes that occurred in the New Madrid seismic zone in 1843 and 1895.

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FIGURE 1

MODERATE/LARGE EARTHQUAKES IN THE CENTRAL UNITED STATES

DATE	LOCALITY	MAGNITUDE	MAXIMUM INTENSITY	SOURCE ZONE
December 16, 1811	New Madrid, Missouri	7.7	XII	New Madrid Fault
January 23, 1812	New Madrid, Missouri	7.7	XII	New Madrid Fault
February 7, 1812	New Madrid, Missouri	7.7	XII	New Madrid Fault
June 9, 1838	Southern Illinois	5.7	VI	Illinois Basin
January 4, 1843	Western Tennessee	6.3	VIII	New Madrid Fault
Unknown, 1860	Central Minnesota	5.0	Unknown	Colorado Lineament
August 17, 1865	Southeastern Missouri	5.3	VII	New Madrid Fault
April 24, 1867	Lawrence, Kansas	5.1	VII	Nemaha Uplift
June 18, 1875	Western Ohio	5.3	VII	Cincinnati Arch
November 15, 1877	Eastern Nebraska	5.0	VII	Nemaha Uplift
October 22, 1882	Arkansas - Texas	5.5	VI - VII	Ouchita - Wichita Fault
July 26, 1891	Illinois - Indiana	5.9	VI	Wabash Valley Fault
October 31, 1895	Charleston, Missouri	6.7	VIII	New Madrid Fault
May 26, 1909	Illinois	5.1	VII	Cincinnati Arch
April 9, 1917	Eastern Missouri	5.0	VI	St. Francois Uplift
March 8, 1937	Western Ohio	5.0	VII - VIII	Cincinnati Arch
April 9, 1952	Enid, Oklahoma	5.1	VII	Nemaha Uplift
November 9, 1968	South Central Illinois	5.5	VII	Wabash Valley Fault
March 24, 1976	Marked Tree, Arkansas	5.0	V – VI	New Madrid Fault
July 27, 1980	North Central Kentucky	5.2	VII	Cincinnati Arch
January 31, 1986	Anna, Ohio	5.0	VI	Cincinnati Arch
June 9, 1987	Lawrenceville, Illinois	5.2	V – VI	Wabash Valley Fault
September 26, 1990	New Hamburg, Missouri	4.8	IV – V	New Madrid Fault
May 3, 1991	Risco, Missouri	4.6	IV – V	New Madrid Fault
June 26, 2000	Harrison, Arkansas	3.9	VIII	Ouchita – Wichita Fault
December 7, 2000	Evansville, Indiana	3.9	V	Wabash Valley Fault
May 4, 2001	Conway, Arkansas	4.4	VI	Ouchita - Wichita Fault
February 8, 2002	Lewton, Oklahoma	3.9	V	Nemaha Uplift
June 18, 2002	Evansville, Indiana	4.6	VI	Wabash Valley Fault
November 3, 2002	O'Neill, Nebraska	4.3	V	Nemaha Uplift
June 6, 2003	Cairo, Illinois	4.0	VI	New Madrid Fault
August 16, 2003	West Plains, Missouri	4.0	V	New Madrid Fault
June 15, 2004	Sikeston, Missouri	3.7	V	New Madrid Fault
June 28, 2004	Ottawa, Illinois	4.2	VI	Illinois Basin
September 17, 2004	Middlesboro, Kentucky	3.7	V	New Madrid Fault
February 10, 2005	Blytheville, Arkansas	4.1	V	New Madrid Fault
May 1, 2005	Blytheville, Arkansas	4.1	V	New Madrid Fault
June 2, 2005	Dyersburg, Tennessee	4.0	IV	New Madrid Fault
August 24, 2005	Greeneville, Tennessee	3.7	IV	New Madrid Fault
January 2, 2006	Harrisburg, Illinois	3.6	II-III	Wabash Valley Fault

DATE	LOCALITY	MAGNITUDE	MAXIMUM INTENSITY	SOURCE ZONE
April 18, 2008	Ogden, IL	4.6	VI	Wabash Valley Fault
April 21, 2008	Gards Point, IL	4.0	V	Wabash Valley Fault
April 25, 2008	Ogden, IL	3.7	V	Wabash Valley Fault
February 10, 2010	Maple Park, IL	3.8	V	Unidentified
March 2, 2010	East Prairie, MO	3.7	IV	New Madrid Fault
October 11, 2010	Guy, AR	4.0	V	Guy-Greenbriar Fault
October 11, 2010	Guy, AR	3.6	V	Guy-Greenbriar Fault
October 15, 2010	Bald Knob, AR	3.8	IV	Guy-Greenbriar Fault
October 16, 2010	Guy, AR	3.5	IV	Guy-Greenbriar Fault
November 20, 2010	Old Texas, AR	3.9	V	Guy-Greenbriar Fault
February 16, 2011	Greenbriar, AR	3.5	IV	Guy-Greenbriar Fault
February 17, 2011	Greenbriar, AR	3.8	IV	Guy-Greenbriar Fault
February 18, 2011	Greenbriar, AR	3.9	V	Guy-Greenbriar Fault
February 18, 2011	Greenbriar, AR	4.1	IV	Guy-Greenbriar Fault
February 20, 2011	Greenbriar, AR	3.6	IV	Guy-Greenbriar Fault
February 25, 2011	Greenbriar, AR	3.6	IV	Guy-Greenbriar Fault
February 28, 2011	Greenbriar, AR	4.7	V	Guy-Greenbriar Fault
February 28, 2011	Greenbriar, AR	3.8	V	Guy-Greenbriar Fault
March 3, 2011	Greenbriar, AR	3.5	IV	Guy-Greenbriar Fault
March 9, 2011	Greenbriar, AR	3.5	IV	Guy-Greenbriar Fault
April 7, 2011	Greenbriar, AR	3.9	V	Guy-Greenbriar Fault
April 8, 2011	Greenbriar, AR	3.9	V	Guy-Greenbriar Fault
April 8, 2011	Greenbriar, AR	3.5	V	Guy-Greenbriar Fault
June 7, 2011	Sullivan, MO	3.9	V	Unidentified
September 22, 2011	Grandin, MO	3.6	IV	Unidentified
February 21, 2012	East Prairie, MO	3.9	IV	New Madrid Fault
October 29, 2012	Parkin, AR	3.9	VI	New Madrid Fault

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ANNEX G

DAM FAILURES

I. TYPE OF HAZARD

Dam Failures

II. DESCRIPTION OF HAZARD

Over the years dam failures have injured or killed thousands of people, and caused billions of dollars of property damage in the United States. Among the most catastrophic were the failures of the Teton Dam in Idaho in 1976, which killed 14 people and caused more than $1 billion in damage, and the Kelly-Barnes Dam in Georgia, which left 39 dead and $30 million in property damage. In the past few years, over 200 documented dam failures have occurred nationwide causing four deaths and millions of dollars in property damage and repair costs. The problem of unsafe dams in Missouri was underscored by dam failures at Lawrenceton in 1968, Washington County in 1975, Fredericktown in 1977, and the December 14, 2005 collapse of the Upper Reservoir of Ameren UE's Taum Sauk hydroelectric complex in Reynolds County. Overall, many of Missouri's smaller dams are becoming a greater hazard as they continue to age, maintenance issues become more expensive and communities downstream of the dams grow. While hundreds of the privately owned dams need to be rehabilitated, the lack of owner funding and the occasional problem of the ownership of the dam looms as obstacles.

A dam is defined by the National Dam Safety Act as an artificial barrier that impounds or diverts water and (1) is more than 6 feet high and stores 50 acre feet or more, or (2) is 25 feet or more high and stores more than 15 acre feet. Based on this definition, there are over 80,000 dams in the United States. Over 95 percent of these dams are non-federal, with most being owned by state governments, municipalities, watershed districts, industries, lake associations, land developers, and private citizens. In Chapter 236 Revised Statutes of Missouri defines a dam as being 35 feet or higher. While by federal definition Missouri has 5,249 dams, using the Missouri definition only 686 dams are under the jurisdiction of the State. In addition to the 5,249 dams that are in the current inventory, there is the fact that dams have been built that are not reported and entered into the inventory. Each year, another 5 to 10 dams are discovered that have not been previously recorded.

Dam owners have primary responsibility for the safe design, operation, and maintenance of their dams. They also have responsibility for providing early warning of problems at the dam, for developing an effective emergency action plan (EAP), and for coordinating that plan with local officials. Currently, about 55.8 % of the regulated dams in Missouri have an EAP and the goal is to have over 95% of these done by the end of 2014. States have the ultimate responsibility for public safety and many states regulate construction, modification, maintenance, and operation of dams, and also implement a dam safety program. The State of Missouri is one such state and has a Dam and Reservoir Safety Council (seven citizens appointed by the Governor) and a Dam Safety Program in the Department of Natural Resources. The jurisdiction of the regulated dams is limited to 13.1 % (686 out of 5,249) of the tallest dams in the state. http://www.damsafetyaction.org/index.php

Dams can fail for many reasons. The most common reasons are as follows:

1. **Piping:** Internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.

2. **Erosion:** Inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.

3. **Structural Failure:** Caused by an earthquake, slope instability or faulty construction.

These three types of failures are often interrelated. For example, erosion, either on the surface or internal, may weaken the dam and lead to structural failure, whereas a structural failure may shorten the seepage path and lead to a piping failure. Observable defects that provide good evidence of potential dam failures are illustrated in Figure 1 of this annex.

Dam construction varies widely throughout the state. Most dams are of earthen construction. Missouri's mining industry has produced numerous tailing dams for the surface disposal of mine waste. These dams are made from mining material deposited in slurry form in an impoundment. Other types of earthen dams are reinforced with a core of concrete or asphalt. The largest dams in the state are built of reinforced concrete and are often used for hydroelectric power. Hydroelectric power dams are regulated by the Federal Energy Regulatory Commission. Two other federal agencies, the US Army Corps of Engineers and the US Forest Service, also regulate dams that are under their control.

III. HISTORICAL STATISTICS

Missouri had some 5,249 recorded dams in December 2013, the third largest number of man-made dams of any state in the United States. The topography of the state allows lakes to be built easily and inexpensively, which accounts for the high number. Despite such a large number, only 686 Missouri dams (about 13 percent) fall under state regulations, while an additional 85 dams are federally controlled. A non-federal dam can be anything from a large farm pond (e.g., MFA Research Farm Lake Dam in Saline County, which is 20 feet high and holds back 60 acre feet of water) to Bagnell Dam, which created the Lake of the Ozarks. Most non-federal dams are privately owned structures built either for agricultural, water supply or recreational use. Missouri also has more than 1,000 dams that were built as small watershed projects under Public Law-566 (Watershed Protection and Flood Prevention Act of 1953). These dams serve many functions, including flood control, erosion control, recreation, fish and wildlife habitat, water supply, and water quality improvement. All of these PL-566 dams need ongoing maintenance to safely provide these functions. Another group of older dams in the state that were originally built by railroad companies as holding ponds for water to be used in steam locomotives. Many of these dams are now used as drinking water reservoirs by nearby towns and cities. Additionally, many mining dams that are no longer used for mining have been sold to private individuals who often do not know the extent of the operational and maintenance requirements that they have assumed by becoming the owner of an old dam. Finally, 37 dams that are over 35 feet are in the category of “Agricultural Exemption” which means they are not inspected and may not meet the standards required of regulated dams.

Within the State of Missouri, the Department of Natural Resources (MDNR) Water Resources Center maintains a Dam and Reservoir Safety Program. The objective is to ensure that dams over 35 feet in height are safely constructed, operated, and maintained pursuant to Chapter 236 Revised Statutes of Missouri. These dams are inspected by a professional engineer at least once every 5 years. The majority of the dams in Missouri are less than 35 feet high and thus, are not regulated. While the State has for many years encouraged dam owners to inspect those unregulated dams, the condition of these small structures and the downstream hazard of these dams have not been updated and is thus unknown.

IV. MEASURE OF PROBABILITY AND SEVERITY

Dams are generally classified in three categories that reflect the potential to do downstream damage if the dam fails. The Federal standards are (High, Significant and Low hazard) that identify the potential hazard to life and property should a failure occur. Missouri has a slightly different classification system (Class 1, Class 2, and Class 3):

1. **High Hazard** (federal classification): If the dam were to fail, lives would be lost and extensive property damage could result. (Class 1 and Class 2 dams by Missouri standards and address loss of life only and not property damage.)

2. **Significant Hazard** (federal classification): Failure would not result in the loss of life but there could be extensive property damage. (Class 3 dams by Missouri standards, no expected loss of life, but expect property damage.)

3. **Low Hazard** (federal classification): Failure results in only minimal property damage. (Class 3 dams by Missouri standards, no expected loss of life, but expect property damage.)

Table G-1 summarizes the states dams by state hazard classification. Table G-2 breaks down the number of dams by county, indicates the state hazard classification of those dams in that county, and tells how many dams in that county are regulated.

A. Status of Missouri Privately-Owned Dams

According to the MDNR 2013 Missouri Dam Database (5,249 dams), 581 dams, or 11.1 percent of the dams surveyed, had a Class 1 hazard classification, while 945 dams, or 18 percent of the dams surveyed had a Class 2 hazard classification. The remaining 3,723 dams, or 70.9 percent of the dams surveyed had a Class 3 hazard potential. Most of Missouri's 4,563 unregulated dams (5,249 – 686=4,563) have gone unchecked for decades because there is no legal authority or state allocated manpower available to inspect them. Dams that don't get regular attention can erode over the years, or may be damaged by floods. These dams can be considered accidents waiting to happen. If a dam fails, regardless of whether it is state regulated or not, the dam owner is still responsible for damage. Information collected from the Army Corps of Engineers 1980 National Inventory of Dams is outdated, and ownership of unregulated dams may have changed. Concern is mounting as the population density below dams continues to rise causing possible hazard classifications to change without it being reflected in the

inventory and unregulated dams continue to age. Additionally, there are a few dams that develop defects that the owners refuse to repair and they must be referred to the Attorney General's office before the owners finally agree to fix the defects noted in their dam.

The State Dam Safety Program has been designated one of three pilot states by the Federal Emergency Management Agency to undertake a program to increase the number of dams with emergency action plans. The first monies to do this were received during the federal fiscal year 2010 and the program will take approximately 5 years to complete. The goal is for all state regulated federally defined high hazard dams (Missouri Class 1 and Class 2 dams) to have an EAP at the conclusion of the 5 year period. This undertaking is a joint effort that involves local emergency planners who would be the individuals that assist owners in executing an EAP if it were activated. http://www.damsafetyaction.org/index.php

B. Missouri's Small Watershed Projects with Dams

In 1954, Missouri built its first small watershed dam, and today has well over 1,000 such dams built under PL-566. These dams vary in size and perform multiple functions, including flood and erosion control. Many have a designed life of 50 years. According to a 1999 report, about 25 of these dams are more than 40 years old, and most will need major rehabilitation soon. More than 130 dams are 30 to 39 years old, while 182 of them are 20 to 29 years old. Some of these dams are now reaching their design life and some Watershed districts are turning the dams over to the land owner who will now be responsible for the maintenance. A case study on the Tabo Creek Watershed Project in Lafayette County Missouri best illustrates the range of problems. The Tabo Creek project was authorized in 1960, with the first dam constructed in 1961. Since then, 64 grade-stabilization dams have been installed in this area alone. Many of these dams now face the same problems that plague older dams in other watersheds approaching the end of their 50-year design life. They include deteriorating pipes and sediment filling the reservoirs. The most common problem is decaying pipes, since 44 of the dams were installed with corrugated metal pipes. One of the most visible problems is the lakes filling with sediment. The Lafayette County Soil and Water Conversation District is responsible for operation and maintenance, and performs annual inspections of each structure. However, the local sponsors simply don't have enough funds available to rehabilitate all the structures. To date, no dams built under the Small Watershed Program anywhere in the U.S. have failed and resulted in loss of life or property. However, some exhibited significant problems that were corrected before a catastrophic failure or tragedy has occurred. The chances of such occurrences will undoubtedly increase, as the dams get older.

C. Federal Agency Operated Reservoir Dams in Missouri

The U.S. Army Corps of Engineers operates and maintains nearly a dozen large federally regulated reservoir dams in Missouri through its Kansas City, St. Louis, and Little Rock Districts. Extensive care is taken by the Corps in the design, construction, and operation of their dams. As a result, the Corps' record for dam safety is considered excellent. Nevertheless, dam failures elsewhere in the country raise the possibility that any one of these facilities could fail. The threat of an earthquake in some areas of the state, the possibility of sabotage or terrorist activities, or other natural or technological events are among the potential risk factors that could cause such a structure to fail.

For its regulated dams, the Corps' Kansas City District began a program in 1999 to revise its Contingency Plans for seven district dams it operates in Missouri. The plans were republished as emergency action plans, to provide an updated emergency notification/points of contact list in the event of a dam failure; to provide for increased communications with local emergency management officials; and to provide a more simplified format for clarity. The Corps' Kansas City District worked jointly with the State Emergency Management Agency (SEMA), the National Weather Service, and local officials, including the county sheriff and emergency management coordinator in the affected counties (24 hours below stream). The plans were updated for Pomme de Terre Dam (Hickory and Benton counties); Blue Springs Dam (Jackson County); Longview Dam (Jackson County); Smithville Dam (Clay and Platte Counties); Long Branch Dam (Macon and Randolph Counties); Stockton Dam (Cedar and St. Clair Counties); and Truman Dam (Benton and Morgan Counties). Two other counties, Schuyler and Putnam, were included in an updated plan for the Corps' Rathbun Dam that runs from Iowa into Missouri.

The Corps' St. Louis District maintains flood emergency plans for its Clarence Cannon Dam/Mark Twain Lake project, with the plan covering Ralls, Monroe, Pike and Shelby Counties; and Lake Wappapello Dam for Wayne, Butler, Stoddard and Dunklin Counties. The Corps' Little Rock District has similar plans for Table Rock Dam, Taney and Ozark Counties; and for Clearwater Dam, Wayne, Butler, and Reynolds Counties. Figure G-3 shows the location of the Corps' Missouri reservoir dams by county, and adjacent counties that could be impacted (emergency notification) by a dam failure.

The Federal Energy Regulatory Commission (FERC) oversees the inspection of power generation dams in Missouri such as the facilities at Taum Sauk and the Bagnell Power Station at the Lake of the Ozarks.

The U.S. Forest Service manages dams in the Mark Twain National Forest. These dams are in very rural locations and do not normally impact cities and towns.

V. IMPACT OF THE HAZARD

When a dam fails, the stored water can be suddenly released and have catastrophic effects on life and property downstream. Homes, bridges, and roads can be demolished in minutes. The failure of the Buffalo Creek Dam in 1972 in West Virginia killed 125 people. The 2005 collapse of the Taum Sauk Upper Reservoir destroyed the house of the superintendent of DNR's Johnsons Shut-ins State Park in Reynolds County. The family of five was rescued by the Lesterville Volunteer Fire Department. At least 26 recorded dam failures have occurred in 20 Missouri counties since the turn of the 20th century. Fortunately, only one drowning has been associated with a dam failure in the state.

Residents near a Class 1 or Class 2 dam should become familiar with the dam's emergency action plans. Emergency plans written by dam owners for dams and include the following:

1. Procedures for notification and coordination with local law enforcement and other governmental entities
2. Agencies information on the potential inundation area
3. Plans for warning and evacuation
4. Procedures for making emergency repairs

VI. SYNOPSIS

Dam breaks are caused most often by failure of the structure itself. These dam breaks normally occur very suddenly and provide little time to warn and evacuate the people that are in harm's way. A dam break normally causes a "tsunami" type wall of water full of debris that precedes the flood wave and causes damage due to the impact of the debris on any object in its way. Thus, the flooding that is the most common hazard associated with dam failure also is more damaging to property than a normal slow rising flood that may come up over period of hours or even days. Prolonged rains and flooding can saturate earthen dams, for example, producing much the same breaching effect as occurs with earthen levees. Flooding can also result in overtopping of dams when the spillway and reservoir storage capacities are exceeded. A large slide may develop in either the upstream or downstream slope of the embankment and threaten to release the impounded water. Complete structural collapse can occur, especially as a result of an earthquake.

Actual dam failure can result not only in loss of life, but also considerable loss of capital investment, loss of income, negative environmental effects and property damage. Loss of the reservoir itself can cause hardship for those dependent on it for their livelihood or water supply.

VII. MAPS OR OTHER ATTACHMENTS

Tables:

- Summary of Dams in Missouri by State Hazard Class: Table G-1.
- Dams in Missouri by County and the hazard classification both total number and number regulated by the State: Table G-2.

Illustrations:

- Observable Defects: Figure G-1.
- Our Aging Dams – Survey of Small Watershed Dams (national summaries): Figure G-2.
- Corps of Engineers Dams Figure G-3.

Table G-1

SUMMARY OF DAMS IN MISSOURI BY STATE HAZARD CLASS

Description	Total Number	Number Regulated By State	Percent Regulated
Class 1 dams	581	215 (366 not reg.)	37 %
Class 2 dams	945	270 (674 not reg.)	28.6 %
Class 3 dams	3723	201 (3522 not reg.)	5.4 %
Total	5249	686 (4563 not reg.)	13.1 %

Table G-2

DAMS IN MISSOURI BY COUNTY AND THE THREAT OF DAM FAILURE IN EACH COUNTY

Number in (#) are dams regulated by Missouri Law

County	Number of Dams	Hazard Potential Classification (Missouri Law)		
		Class 1	Class 2	Class 3
Adair	51	1	5 (1)	45 (2)
Andrew	28	3 (1)	6	21
Atchison	15	1	3 (2)	11 (4)
Audrain	87	3	21	63
Barry	1	0	0	1
Barton	31	0	2	39
Bates	26	3 (1)	5	18
Benton	26	3	5	18 (3)
Bollinger	37	3	9 (2)	25
Boone	128	23 (4)	26 (11)	79 (3)
Buchanan	32	3	8 (2)	21 (2)
Butler	31	1	8	23
Caldwell	26	0	6 (2)	20
Callaway	107	6 (1)	22 (6)	79 (12)
Camden	22	2 (2)	8 (6)	12 (4)
Cape Girardeau	32	10 (3)	6 (3)	16
Carroll	114	1	6	107
Carter	14	2	4	8
Cass	69	14 (5)	16	39
Cedar	10	1	1	8
Chariton	32	1	2 (1)	29
Christian	5	0	2 (2)	3
Clark	54	2 (1)	3 (1)	49
Clay	41	7 (1)	12 (2)	22 (2)
Clinton	26	2 (2)	7 (1)	17 (1)
Cole	33	7 (4)	15 (3)	11 (1)
Cooper	23	0	2	21 (2)
Crawford	75	8 (2)	18 (4)	49 (4)
Dade	11	0	0	11
Dallas	4	0	1	3
Daviess	24	0	5 (3)	19 (2)
DeKalb	66	2 (1)	14 (4)	50 (5)
Dent	36	0	9 (3)	27 (1)
Douglas	5	0	2	3

County	Number of Dams	Hazard Potential Classification (Missouri Law)		
		Class 1	Class 2	Class 3
Dunklin	2	1	1	0
Franklin	145	20 (8)	36 (12)	89 (4)
Gasconade	83	7 (4)	14 (4)	63 (6)
Gentry	22	1	3 (1)	18
Greene	18	8 (2)	4 (2)	6 (1)
Grundy	49	2	6	41 (1)
Harrison	259	2 (1)	3 (2)	254 (1)
Henry	50	0	5 (2)	45 (1)
Hickory	7	1	1	5
Holt	27	3	4	20
Howard	72	5 (1)	3 (1)	64 (4)
Howell	26	2	7	17
Iron	40	11 (6)	10 (4)	19 (2)
Jackson	81	28 (16)	21 (2)	32 (2)
Jasper	14	2	3	9
Jefferson	147	58 (22)	42 (13)	47 (3)
Johnson	96	10 (2)	14 (1)	72 (4)
Knox	84	0	5 (1)	79 (2)
Laclede	18	0	0	18 (1)
Lafayette	187	0	33 (14)	159 (21)
Lawrence	7	0	0	7
Lewis	157	0	8 (4)	149 (3)
Lincoln	68	6 (3)	18 (2)	44 (4)
Linn	59	2 (1)	6	51
Livingston	73	2 (1)	15 (1)	56
McDonald	3	1	0	2 (1)
Macon	56	2	5 (4)	49 (3)
Madison	26	11 (1)	10 (4)	5
Maries	30	1 (1)	5 (2)	24
Marion	49	1	3	45
Mercer	53	3 (2)	6 (2)	44 (2)
Miller	15	3	5 (1)	7 (1)
Mississippi	3	0	0	3
Moniteau	19	2 (2)	4	13
Monroe	25	2	4	25 (2)
Montgomery	87	10 (2)	19 (4)	58 (5)
Morgan	13	1 (1)	2 (1)	10 (2)
New Madrid	1	0	0	1
Newton	20	8 (5)	7 (2)	5
Nodaway	101	1 (1)	9 (2)	91 (10)
Oregon	9	2	1	6
Osage	21	3 (1)	9	9
Ozark	7	1	4 (2)	2
Pemiscot	3	0	0	3
Perry	39	12 (1)	8 (4)	19 (1)
Pettis	28	2 (1)	4	22
Phelps	29	4 (2)	8 (1)	17
Pike	49	2 (1)	14 (4)	33 (4)
Platte	30	7 (4)	9 (1)	14
Polk	13	0	1	12 (1)
Pulaski	14	0	0	15
Putnam	72	0	3 (1)	69
Ralls	32	5 (1)	8 (1)	19 (1)

County	Number of Dams	Hazard Potential Classification (Missouri Law)		
		Class 1	Class 2	Class 3
Randolph	52	3 (1)	10	39 (6)
Ray	49	5 (2)	14 (3)	30
Reynolds	22	13 (8)	2 (1)	7 (2)
Ripley	26	0	9 (6)	17 (7)
St. Charles	125	18 (10)	34 (17)	73 (6)
St. Clair	15	0	1	14
St. Francois	63	19 (9)	29 (12)	15 (6)
Ste. Genevieve	54	17 (8)	18 (4)	19 (3)
St. Louis	47	23 (9)	16 (4)	8 (2)
St. Louis City	1	0	1	0
Saline	23	1	5 (1)	17 (1)
Schuyler	75	2	1	72 (2)
Scotland	53	3 (1)	0	50
Scott	17	3 (2)	2 (1)	12
Shannon	91	1	3 (1)	5 (1)
Shelby	28	2	4	22 (1)
Stoddard	29	7	6	14
Stone	1	1	0	0
Sullivan	137	1 (1)	4 (1)	133 (3)
Taney	8	3	1 (1)	4 (1)
Texas	8	0	2 (1)	6
Vernon	44	2 (1)	4	38
Warren	133	28 (8)	49 (25)	56 (11)
Washington	118	47 (28)	39 (26)	38 (3)
Wayne	36	17 (3)	5 (1)	14 (2)
Webster	19	1	9 (3)	9
Worth	64	1	2	62 (3)
Wright	12	0	5 (1)	7

FIGURE G-1

OBSERVABLE DEFECTS

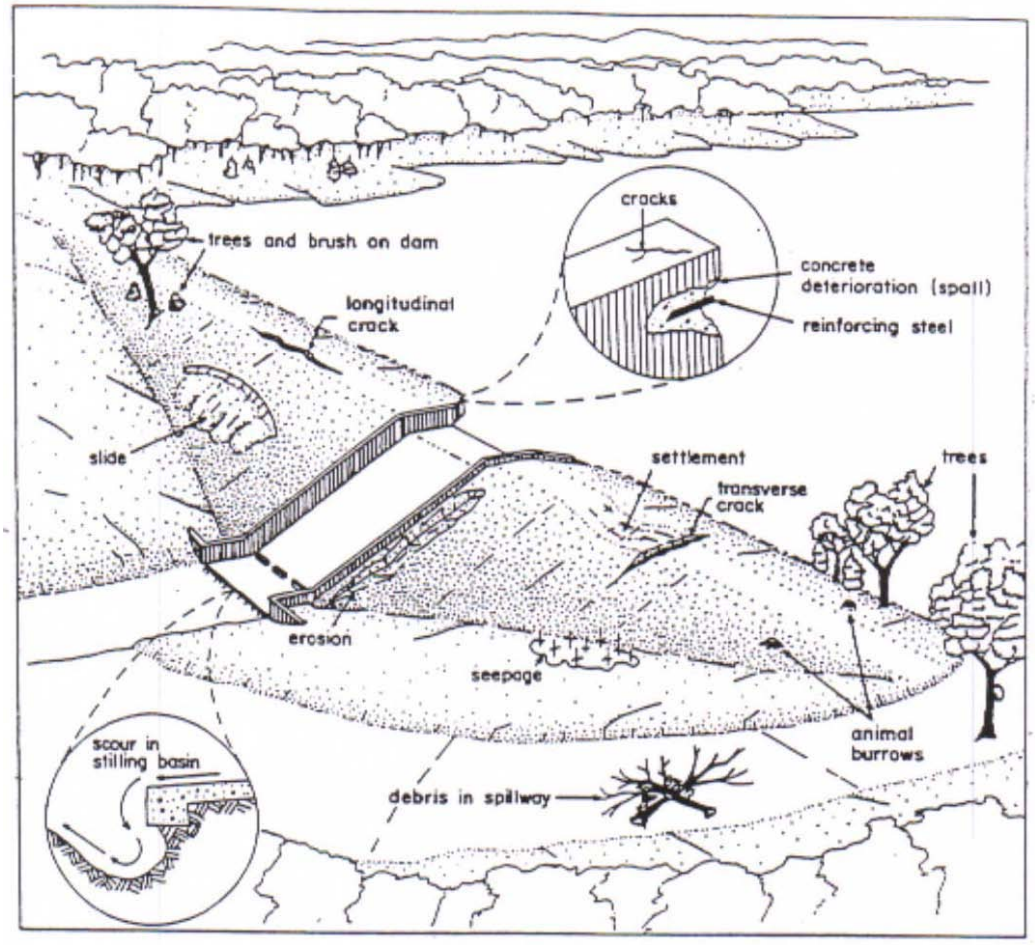

FIGURE G-2

OUR AGING DAMS

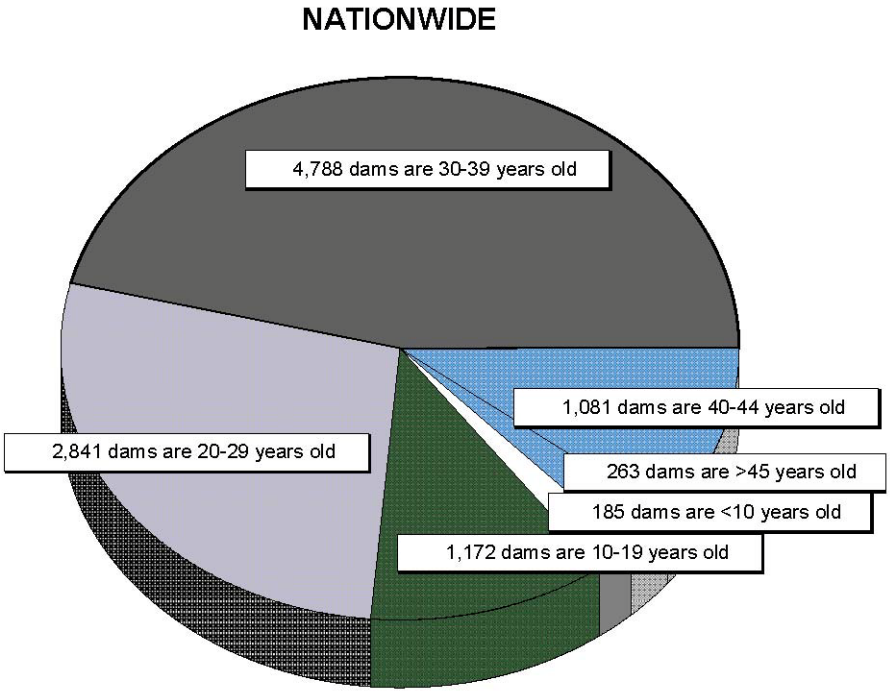

FIGURE G-3

MISSOURI COUNTIES WITH CORPS OF ENGINEERS RESERVOIR DAMS

In the event of a dam failure, emergency warning/notification procedures are provided in both Corps of Engineers flood emergency plans and local county emergency operations plans to alert local officials in the threatened areas. Emergency notification includes the county in which the dam is located, and adjacent/nearby counties below stream that may also be impacted. The Corps maintains such emergency plans for each individual dam, and copies are kept on file with the State Emergency Management Agency.

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MDNR. Division of Dam Safety.

U.S. Army Corps of Engineers. www.usace.army.mil

ANNEX H

UTILITIES
(INTERRUPTIONS AND SYSTEM FAILURES)

I. TYPE OF HAZARD

Utilities—Interruptions and System Failures

II. DESCRIPTION OF HAZARD

Utility interruptions and failures may involve electrical power, natural gas, public water and communications systems. All of these systems or a combination of these utility systems, exist virtually throughout the state. Many utilities are localized and serve only one community, while other utilities serve a regional area. Utilities are often dispersed over a wide area, and many have facilities located throughout their service area. For example, electric companies have multiple transmission and distribution lines serving a community so that if a line goes down there is an alternative line to provide power to the community. Therefore, electricity is lost to as limited an area and for as limited time as possible. Many water companies have some type of back-up, alternative or redundant systems, such as water impoundments, other deep wells, storage tanks or interconnection arrangements with other water companies. Similar switching and rerouting capabilities may exist with communications, while damage to natural gas utilities can often be isolated leaving customers without service for some period of time. Utility systems exist everywhere and are subject to damage from digging, fire, traffic accidents, and severe weather, including flooding and other day-to-day events. Many utilities utilize emergency batteries or generators to provide back-up power for high priority equipment.

Buried cables may be subject to accidental or intentional cuts. However, legislation and mitigation procedures have been taken to prevent such events. In 1990, Senate Bill numbers 214 and 264 required all owners and operators of underground pipeline facilities to participate in the Missouri "One Call" notification center. These bills altered the original Chapter 319 Damage Prevention Act and added a penalty clause. This participation provides for the location of underground pipelines after notification by the excavator and before any excavation work begins. Anyone planning any subsurface digging, drilling, or plowing of any kind is required to use the “One Call” service.

III. HISTORICAL STATISTICS

Because utilities exist everywhere in the state, damage to utility facilities and infrastructure may occur frequently. This may be due to a backhoe cutting a buried line, an accident involving a motor vehicle, a flood or other severe weather. Many of these interruptions or failures go unreported to the Public Service Commission (PSC), and no definitive reporting system exists for most utilities; however, damages to natural gas lines are reported to the Commission Staff annually by all natural gas operators. Therefore, limited statistical information is available. However, the PSC Staff has investigated the electric utilities’ response to numerous ice storms and severe thunderstorms over the last ten years that have disrupted power to hundreds of thousand customers.

A. State Disasters

During the flood of 1993, telecommunications companies proved their adaptability by using cellular service to replace wire line service in areas where service could not be restored in a timely manner. One Local Exchange Company (LEC) utilized a trailer with cellular pay phones where the land lines were interrupted. Another company temporarily replaced analog subscriber carrier service with site-based cellular service. Short-haul portable microwave was also utilized to replace copper lines lost during the flood.

On July 19-20, 2006, severe storms with high winds and possible tornado activity struck the City of St. Louis and the counties of St. Louis, Dent, Iron, Jefferson, St. Charles, and Washington. As a result of the storms approximately 500,000 Ameren customers were without electrical power. Over 3600 utility workers from Ameren and outlying utility company's were involved in restoration efforts, the largest in company history. High priority projects included restoring power to 14 nursing homes, cooling stations, hospitals, city services and utilities and fuel terminals. Compounding the problems, a heat advisory with heat index values as high as 104 degrees plagued recovery efforts for several weeks following the event. For additional information about severe winter weather in Missouri, see Section C of this Hazard Analysis Plan.

In January 2009, a Canadian cold front with a lot of Gulf moisture pushed through Missouri bringing snow, sleet and freezing rain. Over two and one-half inches of ice covered most of the southeast portion of the state. Heavy ice accumulations caused over 3,800 AmerenUE transmission and distribution poles to break. Similar breakages were experienced by municipal and electric cooperative systems and transmission operators Entergy and Southwestern Power Administration, which deliver power to some municipalities in southeastern Missouri. Because of the extent of damage, some people were without power for up to three weeks.

In January 2011 the Missouri Department of Transportation (MODOT) conducted snow-clearing from approximately 1,200 miles of roads in 16 counties that requested help after experiencing record amounts of snow in the previous blizzard in counties that received record amounts of snow. Sixteen of the 44 counties that had record snow requested the assistance from the state. Those counties included Barton, Caldwell, Camden, Dade, Grundy, Johnson, Knox, Lafayette, Lewis, Linn, Livingston, Miller, St. Clair, Schuyler, Sullivan and Vernon. On the afternoon of Jan. 31 a State of Emergency was declared for all of Missouri. The order activated the Missouri State Emergency Operations Plan, which allowed state agencies to assist local jurisdictions with emergency preparation and response. The Governor also activated some 600 members of the Missouri National Guard, so they could be positioned around the state to provide help where it was needed most, and directed that emergency generators be deployed around the state.

Sunday May 22, 2011, a devastating weather event struck Joplin, Missouri, continuing through the cities of Duquesne, Diamond, Granby, Sarcoxie and Wentworth. The National Weather Service identified the event as an EF-5 tornado with winds in excess of 200 miles per hour. The tornado took a direct route through the heart of Joplin's residential and retail district, resulting in hundreds of injuries, deaths and the loss of thousands of homes and businesses. The storm affected electrical power, natural gas, water and communications services. An estimated 3,000 to 4,000 homes were completely destroyed and unserviceable. St John's Mercy Hospital was destroyed.

B. National Blackouts

August 14, 2003 Blackout of the Northeast was a widespread power outage that affected an estimated 10 million people in Ontario and 45 million people in eight northeastern states. The high ambient temperature increased energy demand. This caused the power lines to sag as higher currents heated the lines. Electrified commuter railways were also shut down. The power outages affected air transport and financial markets. The reliability of the electrical grid was called into question.

September 8, 2011 Blackout of the Southwest was a widespread power outage that affected an estimated 1.4 million in California and 1.1 million in Mexico. The outage was the result of 23 distinct events that occurred on 5 different power grids within 11 minutes. The San Diego-Tijuana metropolitan area was hardest hit since traffic lights and the railway system was not operating.

IV. MEASURE OF PROBABILITY AND SEVERITY

Because utilities exist throughout the state and are vulnerable to interruptions or failures, there is a high probability that this hazard may occur at anytime or anyplace. In many cases, these are small isolated events, well within the capabilities of the local utility to address. Therefore, the degree of severity of these day-to-day events may be considered low. Due to long-range planning, regulation, and diligence of the utility operators, major interruptions resulting in a high degree of severity are few and far between. Recent regulatory, planning and structural initiatives designed to minimize interruptions and failures are listed below.

V. IMPACT OF THE HAZARD

Utility outages and interruptions can be very localized, or region-wide. Their greatest impact is generally upon the very young or elderly, who can be expected to have greater health risks associated with resultant loss of heating/cooling systems and with the loss of medical equipment that requires a power source. The loss of potable water can also have a severe impact on residents of the affected area. Loss of communications can also adversely affect the provision of emergency services, making it difficult to contact the services for emergency assistance. In addition, utility outages can cause significant problems within all walks of life as people become more and more dependent on electronic communications, should there be a long-term loss of their data communications.

A. Communications

During 1990, the Telecommunications Staff of the PSC requested that LECs submit plans for disaster recovery. Every LEC in the state submitted a plan that lists practices and procedures for any kind of disasters whether natural or man-made. The PSC has recommended to the telecommunication industry that in the event of an emergency, the various companies and emergency agencies should provide the PSC with points of contact for emergency situations.

In order to mitigate the damage of earthquakes or other disasters, the LECs added bracing to all their central offices for their switching equipment and batteries. Since earthquakes or other disasters may affect electrical service, which is essential for operations, many companies have obtained on-site generators or made contingency arrangements to acquire them in a disaster. For additional information regarding earthquakes in Missouri, see Section F of this Hazard Analysis Plan. Such generators would be needed prior to exhaustion of emergency battery supplies, which may last about 8 hours. During the flood of 1993, one LEC provided emergency power to a central office, which was isolated by flood waters. This was accomplished by driving a flat bed truck through the water with a diesel generator mounted on the bed. The generator was fueled by boat.

Vulnerability of buried telecommunication cables has always been a problem. Steps to prevent cutting of buried telecommunication cables include clearly marking cable routes with above ground pedestals and poles, as well as patrolling the routes by vehicle and air.

For additional information on flooding in Missouri, see Section B of this Hazard Analysis Plan.

B. Electrical Service

Electrical utilities in Missouri prepare for disasters and power outages by developing written plans to follow when abnormal events cause extensive outages to customers. Power outages caused by severe weather have prompted the creation of the PSC's vegetation management rules, 4 CSR 240-23.030, and associated tree trimming plans to ensure above ground power lines are free of potential limbs that could fall on power lines and cause interruptions of power. In addition, ongoing review of emergency plans and training for such events has been implemented.

C. Natural Gas

All intrastate natural gas system operators in the state operate under the jurisdiction of the PSC. These operators must comply with the Commission's Pipeline Safety Regulations, which include emergency response procedures to pipeline emergencies and natural disasters. Natural gas system operators have plans on file with the PSC. Parts of these plans include indexes of utilities and their locations in the state.

In 1989, House Bill 938 provided the Commission with additional legal power to enforce the Pipeline Safety Regulations. In 1990, due in part to the Iben Browning earthquake projection, all utilities were mandated by the Commission to develop natural disaster plans (to include potential impacts of earthquakes) and file the plans with the Commission. The Commission also developed its own plan to respond to a disaster causing an interruption or failure of a utility service. The Iben Browning earthquake projection created a new awareness for the necessity for such disaster response and recovery plans. Several natural gas companies have since stored emergency equipment and survival rations in protected locations. This also resulted in a new demand for excess flow and motion sensing valves on natural gas service lines. Operators also reviewed, updated or increased their mutual aid agreements with other utilities and contractors.

VI. SYNOPSIS

Utility companies are generally well prepared to deal with day-to-day outages. The earthquake threat to statewide and multi-state utilities is the greatest concern to the integrity and operability of Missouri's utilities. Planning, regulation, mitigation and mutual aid are all just a few tools available to reduce, speed recovery and prevent utility interruptions and failures.

VII. MAPS OR OTHER ATTACHMENTS

An earthquake map showing all pipelines and electrical transmission lines is on file with the State Emergency Management Agency's, Earthquake Section. Attachments to this section include the following figures:

- Electrical Cooperatives in Missouri: Figure H-1

- Major Interstate Natural Gas Pipelines in Missouri: Figure H-2

- Power Plants in Missouri: Figure H-3

FIGURE H-1

Source: Association of Missouri Electric Cooperatives

FIGURE H-2

MISSOURI PIPELINES

FIGURE H-3
MISSOURI POWER PLANTS

Utility	Plant Name	City	State	MegaWatt
Albany City of	**Albany**	Gentry	MO	6.2
Ameren Energy Generating Co	**Columbia Energy Center**	Boone	MO	162.8
Anheuser-Busch Inc	**Anheuser Busch St Louis**	St Louis City	MO	26.1
Aquila Inc.	**Nevada**	Vernon	MO	22
Aquila Inc.	**Ralph Green**	Cass	MO	74
Aquila Inc.	**Sibley**	Jackson	MO	524
Aquila Inc.	**Lake Road**	Buchanan	MO	273.3
Aquila Inc.	**Greenwood**	Jackson	MO	244
Aquila Inc.	**Kansas City International**	Platte	MO	36
Aquila Inc.	**South Harper**	Cass	MO	0
Aquila Merchant Services	**Aries II Energy Center**	Cass	MO	0
Associated Electric Coop Inc	**New Madrid**	New Madrid	MO	1200
Associated Electric Coop Inc	**Thomas Hill**	Randolph	MO	1135
Associated Electric Coop Inc	**Unionville**	Putnam	MO	46
Associated Electric Coop Inc	**St Francis Energy Facility**	Dunklin	MO	578
Associated Electric Coop Inc	**Essex**	Stoddard	MO	121.2
Associated Electric Coop Inc	**Nodaway**	Nodaway	MO	207.2
Associated Electric Coop Inc	**Holden**	Johnson	MO	274.2
Bethany City of	**Bethany**	Harrison	MO	8
Bethany City of	**Bethany II**	Harrison	MO	1.6
Butler City of	**Butler**	Bates	MO	13.1
Campbell City of	**Campbell City**	Dunklin	MO	6.5
Carrollton Board of Public Wks	**Carrollton**	Carroll	MO	24
Carthage City of	**Carthage**	Jasper	MO	41.8
Central Electric Power Coop	**Chamois**	Osage	MO	59
Chillicothe City of	**Chillicothe**	Livingston	MO	103.5
Columbia City of	**Columbia**	Boone	MO	94.6
Duke Energy Bollinger LLC	**Bollinger Generating Station**	Bollinger	MO	0
Empire District Electric Co	**Asbury**	Jasper	MO	231.5
Empire District Electric Co	**Empire Energy Center**	Jasper	MO	368
Empire District Electric Co	**Ozark Beach**	Taney	MO	16
Empire District Electric Co	**State Line Combined Cycle**	Jasper	MO	659
Fayette City of	**Fayette**	Howard	MO	10.9
Fulton City of	**Fulton**	Callaway	MO	38.2
Gallatin City of	**Gallatin**	Daviess	MO	7.2
Gallatin City of	**Gallatin #2**	Daviess	MO	3.6
Hercules Incorporated	**Hercules Missouri Chemical Works**	Pike	MO	18.6
Higginsville City of	**Higginsville**	Lafayette	MO	51.6
Independence City of	**Blue Valley**	Jackson	MO	176
Independence City of	**Jackson Square**	Jackson	MO	36
Independence City of	**Station H**	Jackson	MO	43

Independence City of	**Station I**	Jackson	MO	38
Independence City of	**Missouri City**	Clay	MO	46
Jackson City of	**Jackson**	Cape Girardeau	MO	22.3
Kahoka City of	**Kahoka**	Clark	MO	7.4
Kansas City Power and Light Co	**Grand Avenue**	Jackson	MO	83.2
Kansas City Power and Light Co	**Hawthorn**	Jackson	MO	1071.1
Kansas City Power and Light Co	**Montrose**	Henry	MO	564
Kansas City Power and Light Co	**Northeast**	Jackson	MO	486
Kansas City Power and Light Co	**Iatan**	Platte	MO	726
Kennett City of	**Kennett**	Dunklin	MO	44.5
Kinder Morgan Missouri LLC	**Cape Girardeau Power Facility**	Cape Girardeau	MO	0
La Plata City of	**La Plata**	Macon	MO	4.9
Macon City of	**Macon**	Macon	MO	11.2
Macon City of	**Sub 2 Generating Station**	Macon	MO	3.6
Macon City of	**Macon Energy Center**	Macon	MO	10
Macon City of	**Sub 3 Generating Station**	Macon	MO	7.2
Malden City of	**Malden**	Dunklin	MO	17.3
Marceline City of	**Marceline**	Linn	MO	9.6
Marshall City of	**Marshall**	Saline	MO	57.3
Memphis City of	**Memphis**	Scotland	MO	8.8
Merchant Energy Partners	**Aries Power Project**	Cass	MO	677
Monroe City City of	**Monroe**	Monroe	MO	18.8
NRG South Central Ops Inc	**Audrain Generating Station**	Audrain	MO	814.4
Odessa City of	**Odessa**	Lafayette	MO	7.3
Owensville City of	**Owensville**	Gasconade	MO	9.8
Palmyra City of	**Palmyra Municipal**	Marion	MO	6.8
Palmyra City of	**Palmyra Municipal 2**	Marion	MO	7
Poplar Bluff City of	**Poplar Bluff Generating Station**	Butler	MO	39.8
Rich Hill City of	**Rich Hill**	Bates	MO	1.1
Rockport City of	**Rockport**	Atchison	MO	5.7
Salisbury City of	**Salisbury City of**	Chariton	MO	6.4
Shelbina City of	**Shelbina Power #1**	Shelby	MO	4.6
Shelbina City of	**Shelbina Power #2**	Shelby	MO	6.6
Shelbina City of	**Shelbina Power #3**	Shelby	MO	3.6
Sho-Me Power Electric Coop	**Niangua**	Camden	MO	3
Sikeston City of	**Coleman**	Scott	MO	4.3
Sikeston City of	**Sikeston Power Station**	Scott	MO	261
Southeast Missouri State Univ	**Southeast Missouri State University**	Cape Girardeau	MO	7.2
Southwestern Bell Telephone Co	**Southwestern Bell Telephone**	Cooper	MO	6
Springfield City of	**James River Power Station**	Greene	MO	450.5
Springfield City of	**Main Street**	Greene	MO	15.3
Springfield City of	**Southwest Power Station**	Greene	MO	303
Springfield City of	**McCartney**	Greene	MO	117.8
Stanberry City of	**Stanberry**	Gentry	MO	4.9
Trenton Municipal Utilities	**Trenton Diesel**	Grundy	MO	5.2

Trenton Municipal Utilities	**Trenton Peaking**	Grundy	MO	13.5
Trenton Municipal Utilities	**Trenton South**	Grundy	MO	14
Trigen St Louis Energy Corporation	**Trigen St.Louis**	St Louis	MO	33.8
Union Electric Co	**Fairgrounds**	Cole	MO	68.3
Union Electric Co	**Kirksville**	Adair	MO	15
Union Electric Co	**Viaduct**	Cape Girardeau	MO	30.6
Union Electric Co	**Howard Bend**	St Louis	MO	47.4
Union Electric Co	**Labadie**	Franklin	MO	2389.4
Union Electric Co	**Meramec**	St Louis	MO	1041
Union Electric Co	**Osage**	Miller	MO	208
Union Electric Co	**Sioux**	St Charles	MO	1099.4
Union Electric Co	**Taum Sauk**	Reynolds	MO	408
Union Electric Co	**Callaway**	Callaway	MO	1235.8
Union Electric Co	**Rush Island**	Jefferson	MO	1242
Union Electric Co	**Mexico**	Audrain	MO	60.7
Union Electric Co	**Moberly**	Randolph	MO	60.6
Union Electric Co	**Moreau**	Cole	MO	60.8
Union Electric Co	**Peno Creek**	Pike	MO	240
Unionville City of	**Unionville**	Putnam	MO	8.7
University of Missouri-Columba	**University of Missouri Columbia**	Boone	MO	91.1
USCE-Kansas City District	**Stockton**	Cedar	MO	45.2
USCE-Kansas City District	**Harry Truman**	Benton	MO	161.4
USCE-Little Rock District	**Table Rock**	Taney	MO	200
USCE-St Louis District	**Clarence Cannon**	Ralls	MO	58
Vandalia City of	**Vandalia**	Audrain	MO	9.3

Source: www.powerplantjobs.com

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ANNEX I

FIRES
(STRUCTURAL, URBAN, AND WILD)

I. TYPE OF HAZARD

Fires (Structural, Urban, and Wild)

II. DESCRIPTION OF HAZARD

Fires can range in scope to include structural, urban, and wild fires. For the purpose of this analysis, structural and urban fires are considered in one category, with wild fires, including forest, prairie, and grassland locations, considered separately.

Structural fires are a major problem that can affect any area of the state. The Missouri Division of Fire Safety (MDFS) indicates that approximately 90 percent of the fire departments in Missouri are staffed with volunteers dedicated to the task of fire prevention and suppression. Whether paid or volunteer, departments are often limited by lack of resources and financial assistance. The impact of a fire to a single-story building in a small community may be as great as that of a larger fire to a multi-story building in a large city.

Because fires can occur anywhere in the state, the MDFS continues to actively promote the enactment of a statewide fire code. Although no statewide code has been enacted to date, successful legislative efforts to improve fire safety have included the following:

1. Fire, Safety, Health, and Sanitation Inspections of Child Care Facilities (RSMo 210.252)
2. Boiler and Pressure Vessel Safety Act (RSMo 650.200)
3. Elevator Safety Act (RSMo 701.350).
4. Fireworks Safety Act (RSMo 320-111)
5. Amusement Ride Safety Act (RSMo 316.200-211)
6. Inspections of Long Term Care Facilities (RSMo 198.074)
7. Missouri Blasting Safety Act (RSMo 319.300)
8. Fire-Safe Cigarette Act (RSMo 320.353)

Fires impact many aspects of society in terms of economic, social, and other indirect costs. According to the MDFS, the most costly crime in the state is arson. This should be of great concern to citizens, law enforcement, the judicial system, and the fire service sector. Fires caused by arson impact citizens through higher insurance premiums, lost jobs, loss of lives, injuries, and property loss. Primary duties of the Missouri State Fire Marshal include the investigation of fires, explosions, and any related occurrences. The investigative staff is responsible for investigating any fire requested by fire service and law enforcement within the state. This also includes explosions, bombings, and all other related offenses.

Presently, the MDFS investigative staff includes 1 deputy chief, 2 regional chiefs and 15 field investigators. This staff must cover all 114 counties and is dedicated to assisting any local or state agency and conducting quality investigations. The investigators are trained in several fields of expertise, including arson for fraud, explosives recognition, and post-blast training.

The MDFS Training Unit develops and oversees the training curriculum being provided regionally for state certification of fire fighters, fire investigators, fire inspectors, and fire service instructors. Although fire fighter certification is not mandatory in Missouri, currently over 25,000 individuals have been awarded over 712,000 certifications by the MDFS.

The MDFS also oversees administration of the statewide fire mutual aid system. This system coordinates response of the fire service assets to assist other jurisdictions during times of emergency and disaster. To compliment the statewide fire mutual aid system, an incident support team (IST) concept has been developed in regions of the state. These teams are available to assist agencies in the management of major fires, and man-made or natural disasters. Figure I-1 shows the Fire/Rescue Mutual Aid Regions in Missouri.

The MDFS is responsible for the enforcement of fireworks laws throughout Missouri. In addition to conducting inspections of any facilities involved with fireworks, approximately 1,470 permits are issued yearly to manufacturers, wholesalers, and retailers of fireworks.

The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately-owned and state-owned forests and grasslands from the destructive effects of wildfires. To accomplish this task, eight forestry regions have been established in the state to assist with the quick suppression of fires (see Figure I-2). The Forestry Division works closely with local fire departments and Federal partners to assist with fire suppression activities. Currently, nearly 800 rural fire departments have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed; a cooperative agreement with the Mark Twain National Forest is renewed annually. Figure I-3 illustrates the 12 Mark Twain National Forest Districts across Missouri.

Forest and grassland fires can occur any day throughout the year. Each year, an average of about 2,800 wildfires burn more than 43,300 acres of forest and grassland in Missouri. Most of the fires occur during the spring season, normally between February 15 and May 10. The length and severity of burning periods largely depend on the weather conditions. Spring in Missouri is noted for its low humidity and high winds. These conditions, together with below-normal precipitation and high temperatures, result in extremely high fire danger. In addition, due to the continued lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper fire-fighting efforts, as decreasing water supplies may not provide for adequate fire fighting suppression. Spring is when many rural residents burn their garden spots, brush piles, and other areas. Many landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, with the possibility of extremely high fire dangers and the increased opportunities for fires, the spring months are the most dangerous for wildfires. The second most critical period of the year is fall.

III. HISTORICAL STATISTICS

Because buildings exist anywhere people live and work, fires can occur at anytime and anyplace throughout the state. The frequency of structural fires depends on a wide range of factors. These factors include, but are not limited to population or building density, building use, lack of fire codes, lack of

enforcement when fire codes exist, fire safety practices (or lack thereof) by building occupants, lack of adequately equipped fire departments, and criminal intent related to arson.

Data on the frequency of structural fires is included in the National Fire Incident Reporting System Statistics (NFIRS) data provided by the MDFS (See Table I-1 below). Out of the 881 fire departments in the state, approximately 47% of those are registered in the NFIRS system. (The percentage of these departments that actively enter data is lower than this mark.) Without 100% reporting, definitive conclusions are not possible; however, fire departments, law enforcement offices and other agencies spend considerable manpower and funding to respond to and investigate structural fires.

TABLE I-1

Year	Total Fires	Total Fire Dollar Loss	Fire Related Injuries	Fire Related Deaths
2002	19,749	$ 80,184,764	225	39
2003	22,097	$ 68,193,344	272	48
2004	30,731	$103,699,511	371	86
2005	24,182	$ 99,120,053	319	51
2006	29,865	$1,238,056,662	377	70
2007	27,324	$4,156,015,816	375	70
2008	24,647	$9,343,081,187	12	68
2009	11,249	$2,403,928,970	259	54
2010	29,486	$6,127,398,711	370	75
2011	21,922	2,125,109,178.00	278	47
2012 (year to date)	12,771	4,094,496,666.00	193	28

The Forestry Division of the MDC is responsible for protecting the privately-owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry regions have been established. At the present time, the forestry districts afford intensive fire protection to approximately one-half of the state, or about 16 million acres. Within these regions, fairly accurate forest and grassland fire statistics are available from the MDC. In a typical year, approximately 2,800 wildfires occur. In 2012, 4,982 wildfires occurred in Missouri, burning 51,748 acres. Debris burning (fires resulting from land clearing, burning trash, range, stubble, right-of-way, logging slash, etc.) is the major cause of forest and grass fires in Missouri. Incendiary fires (fires willfully set by anyone on property not owned or controlled by him, and without the consent of the owner) continue to rank near the top in the number of wildfires that occur each year.

Table I-2 below lists the number and causes of forest and grassland fires in 2012 and the acres burned. Table I-3 shows the number of fires and acreage burned by forest and grassland fires yearly from 1990 to 2012 and fires and acres to date through 2013.

TABLE I-2

2011 STATEWIDE FIRES BY CAUSE

Cause	Number	Acres	% Number	% Acres
Arson	208	6,452	4.17 %	12.47%
Campfire	53	321	1.06%	0.62%
Children	65	265	1.30%	0.51%

Debris	1,499	10,901	30.08%	21.07%
Equipment	373	4,712	7.48%	9.11%
Lightning	89	751	1.78%	1.45%
Miscellaneous	683	9,781	13.71%	18.90%
Not Reported	81	937	1.62%	1.81%
Railroad	18	65	0.36%	0.12%
Smoking	126	525	2.52%	1.01%
Unknown	1,787	17,039	35.87%	32.93%
TOTAL	**4,982**	**51,748**	**100.00%**	**100.00%**

In north and west-central Missouri, the MDC has limited firefighting forces. Forestry Division personnel, however, provide training and limited federal excess equipment to the many volunteer rural fire departments. See Figure I-2 for a map of the MDC Forestry Regions.

TABLE I-3

STATEWIDE FIRES AND ACRES BURNED

Year	Fires	Acres	Ave. Ac/Fire
1990	3,052	44,202	14
1991	4,253	75,991	18
1992	6,474	83,650	13
1993	2,994	31,952	11
1994	2,748	52,012	19
1995	3,180	55,173	17
1996	5,800	123,889	21
1997	2,362	29,143	12
1998	1,112	10,415	9
1999	1,348	18,270	14
2000	4,919	132,718	27
2001	2,972	41,092	14
2002	2,376	54,37	23
2003	2,378	47,692	20
2004	1,895	28,146	15
2005	1,610	38,921	24
2006	3,553	52,419	15
2007	2,160	20,412	9
2008	2,305	22,309	10
2009	5,262	84,665	16
2010	3,671	42,854	12
2011	3,095	40,420	13
2012	4,982	51,748	11
2013 (year to date)	1,345	9,134	7

IV. MEASURE OF PROBABILITY AND SEVERITY

Even with the limited data in the NFIRS statistics, the property loss from structural and urban fires in Missouri during the first nine months of 2012 was calculated to be over $4 billion, indicating that the probability of structural fires is quite high. In addition, there were 28 fire-related deaths in Missouri for the same period of 2012. Therefore, severity could be considered moderate. The probability of wildfires (forest, prairie, and grassland) is considered moderate overall, but has the potential to increase to high under conditions of excessive heat, dryness, or drought as witnessed during the extended "summer fire season" of 2012.

V. IMPACT OF THE HAZARD

Structural and urban fires are a daily occurrence throughout the state. An average of 55fatalities occurred annually over the past decade, as well as numerous injuries affecting the lives of the victims, their families, and many others—especially those involved in fire and medical services. Unlike other disasters, structural fires are often insidious and despicable due to the prevalence of arson. All citizens pay the costs of arson whether through increased insurance rates, higher costs to maintain fire and medical services, or the costs of supporting the criminal justice system.

VI. SYNOPSIS

With sufficient mutual aid, local fire services have adequate day-to-day fire service capabilities. The greatest risk of interaction by fires with other hazards may involve damaging earthquakes. In these circumstances, the possibility of numerous fires and reduced firefighting capabilities would greatly increase the severity of structural fires.

VII. MAPS OR OTHER ATTACHMENTS

- Fire/Rescue Mutual Aid Regions: Figure I-1
- Missouri Department of Conservation Forestry Regions: Figure I-2
- Mark Twain National Forest Districts: Figure I-3.

FIGURE I-1

MISSOURI FIRE AND MUTUAL AID REGIONS

FIGURE I-2

MISSOURI DEPARTMENT OF CONSERVATION FORESTRY REGIONS

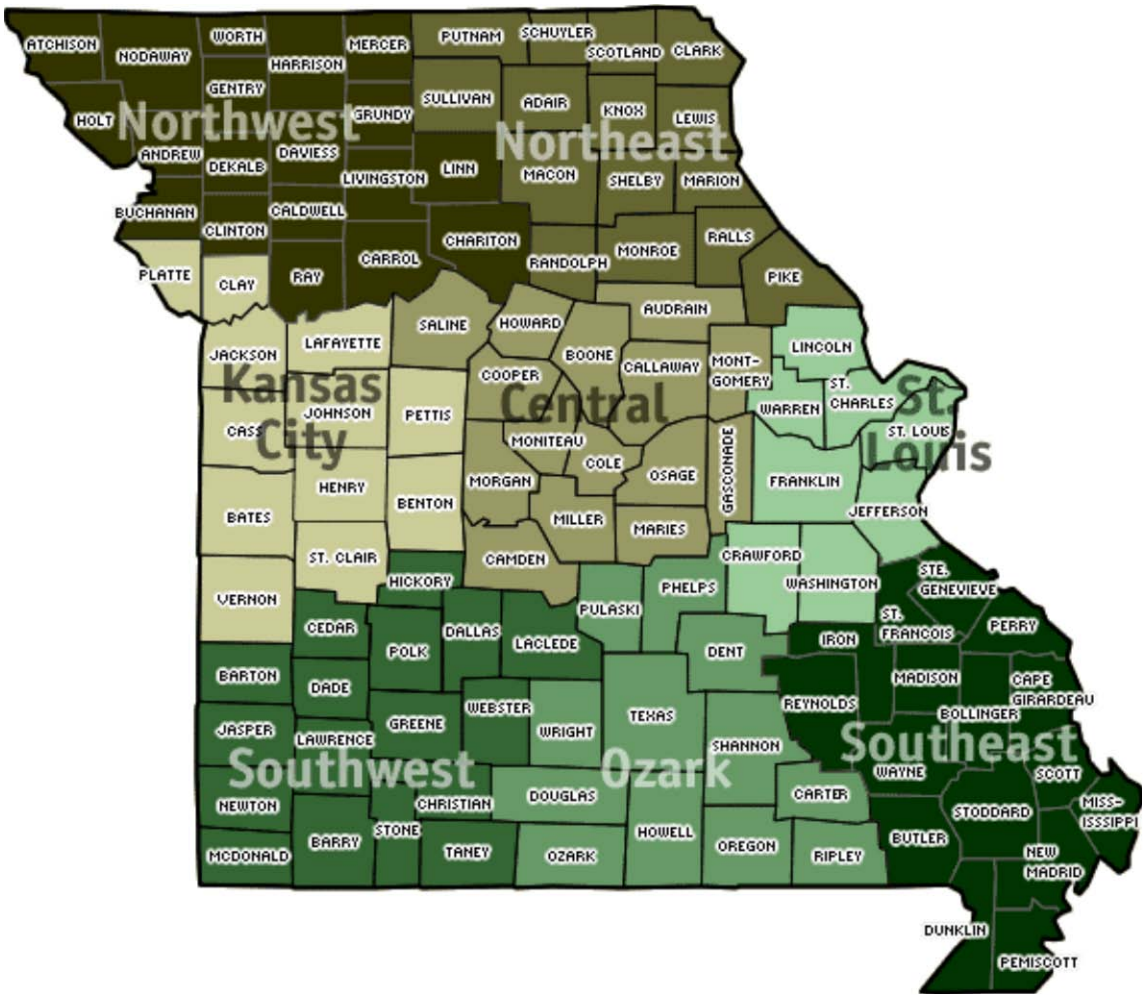
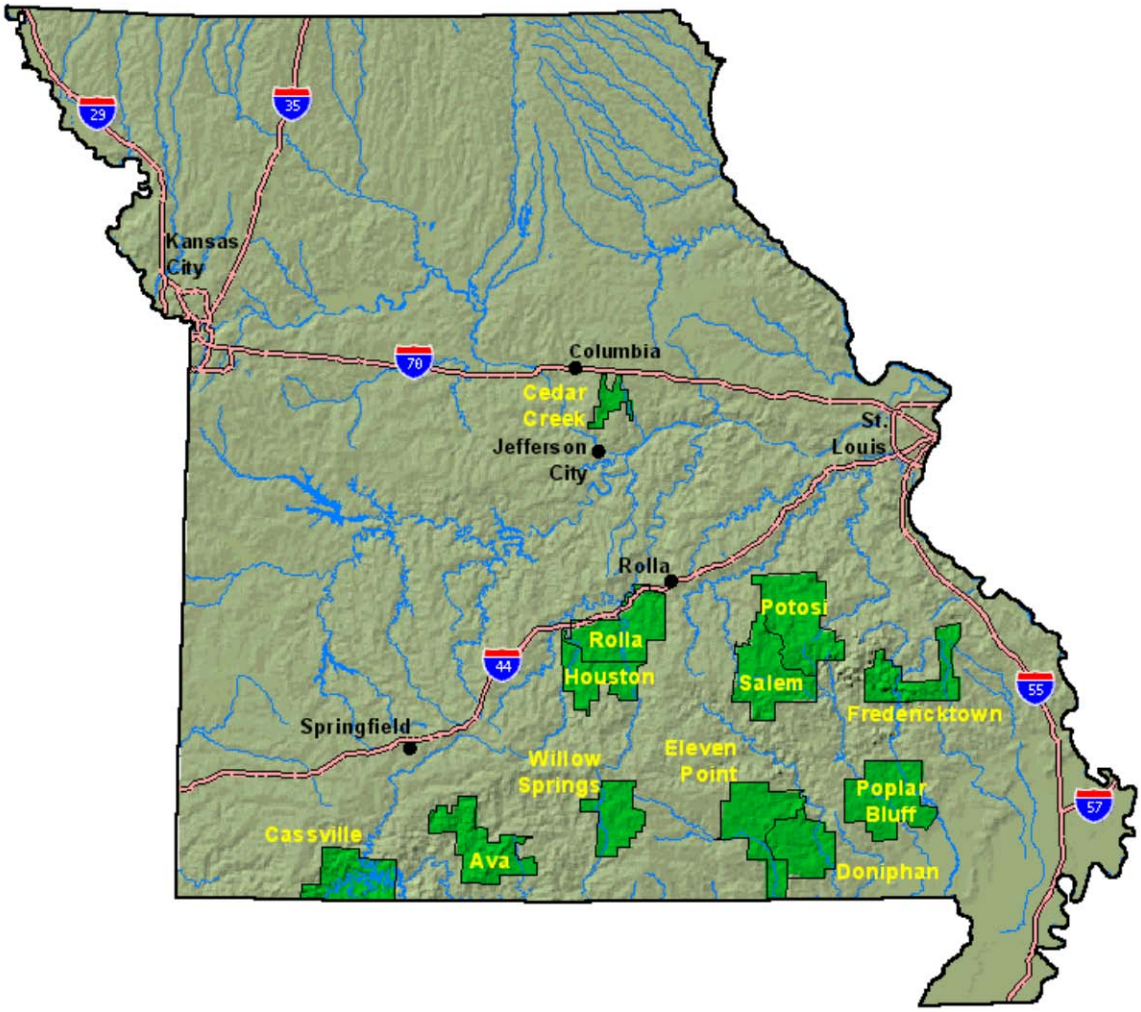


FIGURE I-3

MARK TWAIN NATIONAL FOREST DISTRICTS



VIII. BIBLIOGRAPHY

Missouri Department of Conservation. www.mdc.mo.gov

Missouri Division of Fire Safety. www.dfs.dps.mo.gov

ANNEX J

NUCLEAR POWER PLANTS
(FIXED NUCLEAR FACILITIES)

I. TYPE OF HAZARD

Nuclear Power Plants (Fixed Nuclear Facilities)

II. DESCRIPTION OF HAZARD

There are presently four fixed nuclear facilities or reactors that under extreme circumstances and conditions could pose a threat to citizens of Missouri. These four reactors fall into two categories: research reactors and commercial nuclear power reactors. The first category, research reactors, represents a hazard only to personnel or others on site at the facility. Therefore, these reactors are not included in state radiological plans involving off-site emergency preparedness. For the second category, commercial nuclear power reactors, a worst-case scenario involving a significant release of radioactive material could force the evacuation of the general population within a 10-mile radius of the facility. A release of this magnitude could also contaminate food and water sources within a 50-mile radius.

The magnitude of releases from nuclear plant sites vary depending on the nature of the accident type, reactor design, and meteorological conditions during the release. The Nuclear Regulatory Commission (NRC) and Federal Emergency Management Agency (FEMA) have developed regulatory guidance that both the state and utility must meet to protect the health and safety of the general population within the 10-mile Emergency Planning Zone (EPZ). Four classes of Emergency Action Levels are used for early notification of incidents, with clear instructions for emergency organizations within the EPZ. The four emergency classifications listed in progression of severity are notification of unusual event, alert, site area emergency, and general emergency. These levels are discussed below.

A. Notification of Unusual Event

This classification describes unusual events that are in process or have occurred and indicates a potential degradation of the safety level of the plant. No releases of radioactive material requiring off-site response or monitoring are expected unless safety systems are further degraded.

B. Alert

This classification describes unusual events that are in process or have occurred and indicate a potential degradation of the level of plant safety. Any releases are expected to be limited to small fractions of the Environmental Protection Agency (EPA) Protective Action Guideline (PAG) exposure levels.

C. Site Area Emergency

This classification level describes events in process or having occurred that involve actual or likely major failures of the plant functions needed to protect the public. No releases are expected to exceed EPA PAG exposure levels except near the site boundary.

D. General Emergency

This classification describes an event in process or having occurred that involves actual or imminent substantial core degradation or melting, with the potential for loss of containment integrity. Releases can reasonably be expected to exceed the EPA PAG exposure levels off-site for more than the immediate site area.

III. HISTORICAL STATISTICS

A. Research Reactors

Two research reactors are located in the State of Missouri: the Missouri University of Science and Technology-Rolla Reactor (MUSTRR) and the University of Missouri Research Reactor (MURR). The maximum hypothetical accident from either research reactor would place at risk only personnel working at the facilities or the public within the site boundary of the respective facilities. Both research reactors have emergency plans approved by the Nuclear Regulatory Commission (NRC) that conform with regulatory requirements in 10 CFR 50, Appendix E, and follow the guidance provided by Revision I to NRC Regulatory Guide 2.6, Emergency Planning for Research and Test Reactors, March 1982, and ANSI/ANS-15.16, Emergency Planning for Research and Test Research Reactors, November 29, 1981.

B. MUSTRR

MUSTRR is a water-moderated pool-type reactor licensed to operate at 200 KW. The MUSTRR is used for training and research purposes. Because the reactor is mainly used for training, it is not operated for long periods of time. The reactor is located on the east side of the Rolla campus near 14th Street and Pine Street in Rolla, Missouri. Due to the low power of licensing (200 KW), prevailing standards and guidelines do not require the establishment of an emergency planning zone. Therefore, no classification higher than a Site Area Emergency has been included in the MUSTRR emergency plans. The MUSTRR has been in operation since December 1961 and has never had an incident that would be considered an emergency action level.

C. MURR

MURR is a 10 MW pressurized water-moderated pool-type reactor with a containment building. The MURR is used to provide research, training, and services to the four campuses of the University of Missouri system, other universities, government agencies, and private industry as well. The reactor is located on a 550-acre tract of land south of the University of Missouri-Columbia campus on Providence Road. The MURR has an emergency planning zone encompassing the area within a 100-meter radius from the exhaust stack. No credible potential accidents have been identified for the MURR facility that would result in exceeding the classification of Notification of Unusual Events. As a result, no classification higher than a Site Area Emergency is included in the emergency plan for the MURR. The MURR has been in operation since October 1967. The reactor averages 8,060 hours of operation per year (155 hours per week) at peak flux due to the service work that it performs. During its history of operation, the MURR has never had an incident that would be considered an emergency action level.

D. Commercial Nuclear Power Reactors

Two commercial nuclear power reactors could have an impact on the health and safety of Missouri citizens. These reactors are the Callaway Nuclear Plant and the Cooper Nuclear Station, both of which are used for electrical power generation. Both utilities have emergency plans that conform to NUREG-0654, FEMA-REP-1 Rev.1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants. The utilities and the state are required to demonstrate annually various elements of preparedness through radiological emergency drills evaluated by inspectors representing the Federal Emergency Management Agency (FEMA) and the NRC.

E. Callaway Energy Center

The Callaway Plant consists of one unit with a pressurized water reactor capable of providing 1360 megawatts of electricity. The plant is located in Callaway County, Missouri, and is owned and operated by Ameren Missouri, St. Louis. It is located 10 miles southwest of Fulton, 25 miles northeast of Jefferson City, 5 miles north of the Missouri River, and 80 miles west of St. Louis. The population within the 2.5-mile radius of the plant is low (approximately 90 residents). Approximately 8,000 people reside within a 10-mile radius of the plant. The plume exposure pathway has been expanded beyond the 10-mile radius to include the City of Fulton (population 12,000). Thus, the population within the plume exposure pathway is approximately 20,000. The plant site consists of 7,200 acres of land at the site, 6,800 of which are administered by the Missouri Department of Conservation as the Reform Conservation Area. Under this program, part of the area continues to be farmed, with income from farming providing funds for wildlife management and public recreation activities. Land within a 5-mile radius of the plant site is rural, consisting of 60 percent forest, 20 percent farm/crop land, and 20 percent pasture.

F. Cooper Nuclear Station

The Cooper Nuclear Station is a direct-cycle boiling water-type reactor with a net electrical generating capacity of 800 megawatts. The facility is owned by the Nebraska Public Power District of Columbus, Nebraska. The plant is located on the Nebraska side of the Missouri River in Brownville, Nebraska, approximately 7 miles southwest of Rock Port, Missouri. The emergency planning zone within the Missouri side of the river is predominantly rural land, except for the towns of Rock Port, population 1318, Phelps City, population 24, Langdon, population 32, and Watson, population 100. Atchison County is primarily affected by the emergency planning zone and is intersected by several major highways, including Interstate 29, U.S. Highway 136, U.S. Highway 275, and Missouri Highway 111. The total population at risk from a radiological incident in Atchison County is as follows: within 2 miles, approximately 7 people; within 5 miles, approximately 294 people; and within 10 miles, approximately 2,215 people.

IV. MEASURE OF PROBABILITY AND SEVERITY

The consequences of a radiological incident originating from one of the commercial nuclear power plants affecting the state can range in severity from insignificant to a high degree of radioactive contamination within the a 2- to 10-mile radius surrounding the facility. The most crucial concerns during a severe incident are safe evacuation and controlled access to the areas affected by a release of radioactive materials. In the aftermath, the main concerns are as follows: the extent of property needing to be decontaminated, contaminated food sources, and the time required to reach acceptable exposure rates and to allow the safe reentry of the public. Historically, due to their safe operation records, fixed nuclear

facilities have not represented a high risk to the state. The Reactor Safety Study conducted by the NRC rated the chances of a major nuclear disaster as very low (a probability of one in one million per plant operating year). The report concluded that the worst accident type that could affect a nuclear power plant would be one resulting in a meltdown, which could be expected to occur once in 20,000 years of reactor operation. The report also stated that a meltdown would likely cause less than one fatality or injury. This low hazard rating is due to all of the added safety engineered instrumentation used to monitor and shut down nuclear plant systems before any severe damage occurs.

V. IMPACT OF THE HAZARD

An incident at a nuclear power plant resulting in a General Emergency and evacuation (one where a release from the site boundary would be expected) could have a dramatic psychological impact on the uninformed population within the evacuation zone. The utilities and the State of Missouri have an active Radiological Emergency Preparedness program to prepare local jurisdictions and the general population surrounding the plant for responding to such an incident. This program includes in-depth training of resources both from the state and local jurisdictions, and regularly scheduled drills and exercises evaluated by the Federal Emergency Management Agency. Extensive planning has focused on implementation of the emergency response plan for both the state and local jurisdictions. Emphasis is placed on prompt notification of emergency organizations and the public; evacuation routes; reception and care centers for evacuees; monitoring for radiological contamination; emergency worker preparedness; and public information in the form of brochures distributed to residents within the emergency preparedness zone. These programs are essential to the protection of the general public.

VI. SYNOPSIS

Nuclear reactors have been designed to survive natural disasters such as tornadoes and earthquakes without damage to critical systems. Considerable emphasis is placed on multiple-level governmental reviews of the design, construction, and operation of each nuclear power plant. These safety reviews begin prior to construction and continue throughout the operating life of the plant. Radiological planning and preparedness programs monitored by state and federal agencies are in place to ensure that emphasis is placed on the safety of the general public within the emergency planning zone. In addition, the historical record for nuclear power plants gives no indication that a serious accident involving a nuclear power plant will occur.

VII. MAPS OR OTHER ATTACHMENTS

The following figures are attached to this annex:

- Emergency Planning Zone for Callaway Nuclear Power Plant, Figure J-1
- Emergency Planning Zone for Cooper Nuclear Station, Figure J-2
- Emergency Planning Zone for MURR, Figure J-3.

FIGURE J-1

EMERGENCY PLANNING ZONE FOR CALLAWAY NUCLEAR POWER PLANT

FIGURE J-2

EMERGENCY PLANNING ZONE FOR COOPER NUCLEAR STATION

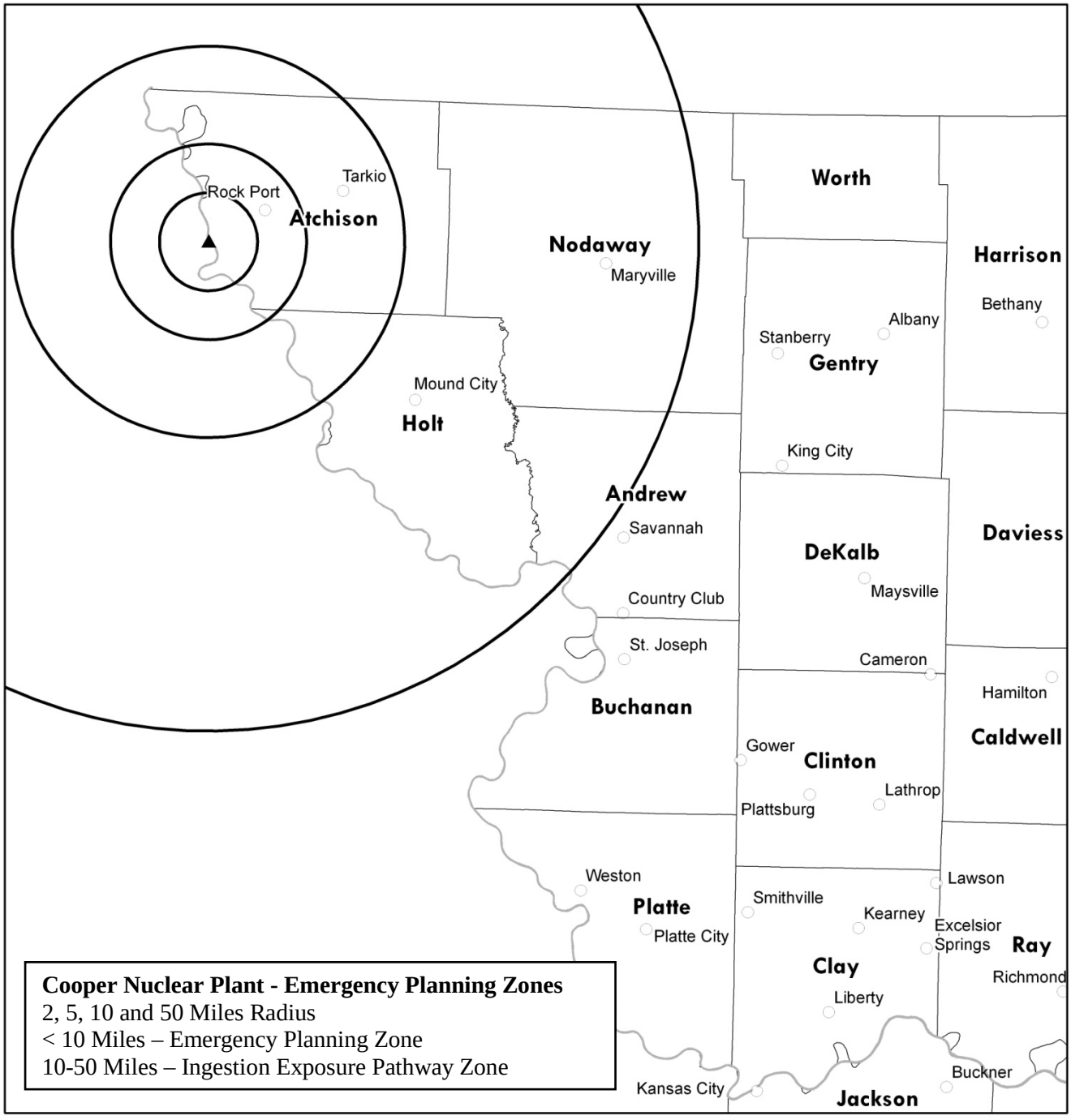
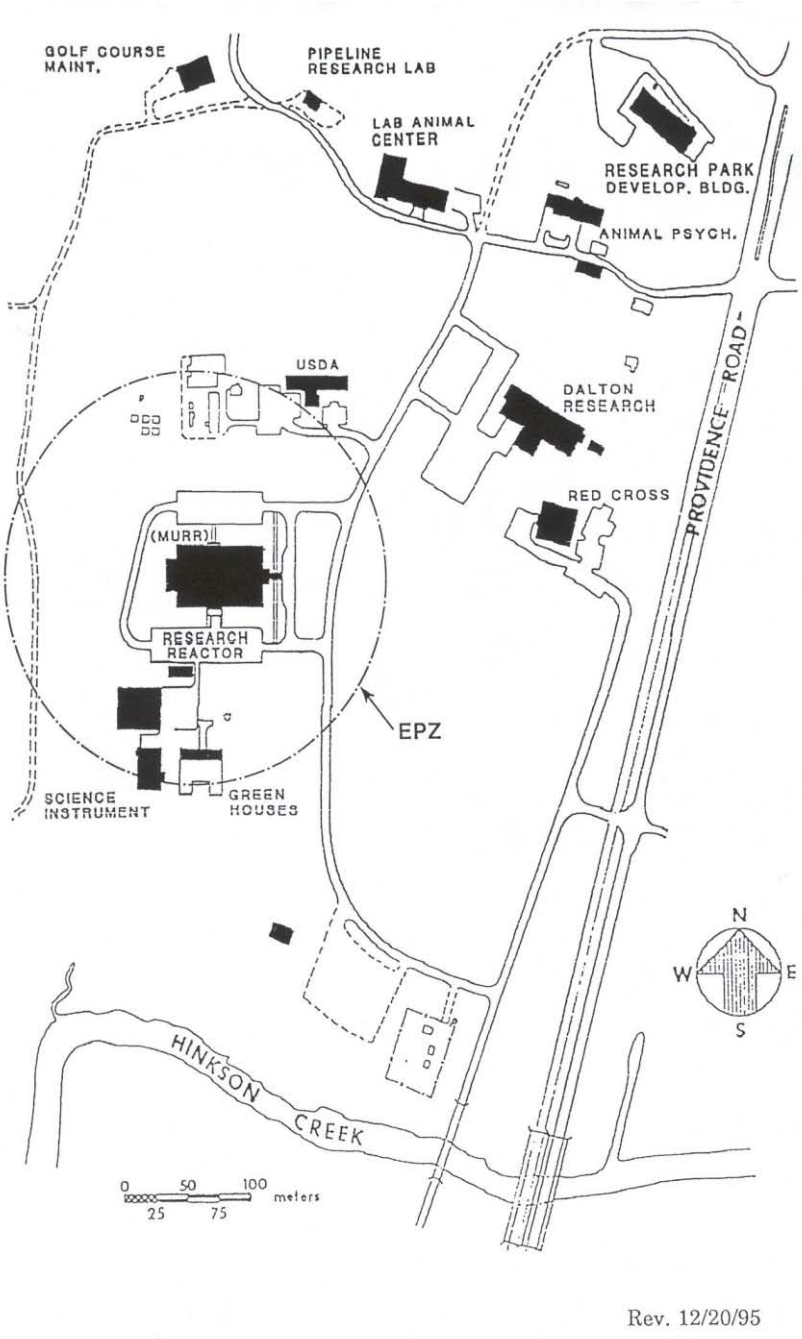


FIGURE J-3

EMERGENCY PLANNING ZONE FOR MURR



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Callaway Facility, “Missouri Nuclear Accident Plan.”

Cooper Facility, “Missouri Nuclear Accident Plan.”

ANNEX K

HAZARDOUS MATERIALS

I. TYPE OF HAZARD

Hazardous Materials

II. DESCRIPTION OF HAZARD

A hazardous material is any substance or material in a quantity or form that may pose a reasonable risk to health, the environment, or property. The category Hazardous Materials includes incidents involving substances such as toxic chemicals, fuels, nuclear wastes and/or products, and other radiological and biological or chemical agents. For the purposes of this hazard analysis section, only accidental or incidental releases of hazardous materials from two different kinds of incidents are addressed: fixed facility incidents and transportation-related accidents. In consideration of recent worldwide and national events, incidents involving terrorism or national attacks, which involve hazardous materials of any type, are addressed in the Terrorism, Attack, and Special Events Considerations annexes of this State Hazard Analysis (Annexes N, O, and Q, respectively).

Generally with a fixed facility, the hazards are pre-identified, and the facility is required by law to prepare a risk management plan done and provide a copy of this plan to the local emergency planning commission (LEPC) and local fire departments. Missouri Tier II forms must also be filed with the Missouri Emergency Response Commission (MERC) at the State Emergency Management Agency (SEMA). For specific site plans, each county LEPC is required by law to maintain a copy of these plans.

The exact location of a hazardous materials accident is not possible to predict. The close proximity of railroads, highways, waterways, and industrial facilities to populated areas, schools, and businesses could put a large number of individuals in danger at any time. In addition, essential service facilities, such as police and fire stations, hospitals, nursing homes, and schools near major transportation routes in the state are also at risk from a potential hazardous materials incident.

Federal Highway Administration statistics indicate that 1 of 10 motor vehicles is engaged in the transport of hazardous materials of some type. The U.S. Army Corps of Engineers also indicates that over 9,000 tons of petroleum products and over 200,000 tons of chemicals and related products are shipped annually by river barge via the Missouri River between Omaha and Kansas City.

Previous estimates have indicated that nationwide, over 4 billion tons of hazardous materials are shipped each year by various transportation modes. Approximately 20 flights each day out of Lambert Airport in St. Louis carry nuclear medicines, and Tri-State Motor Transit Company of Joplin has approximately 25 shipments of high explosives each week.

Missouri is also at risk because of the highway system and geographical location. With Interstate highways such as I-29, I-35, I-44, I-55 and I-70, Missouri offers premium routes for commercial carriers traversing the continental United States. Even arterial highways in Missouri, such as U.S. Highways 71, 13, 63, 54, and 61 are maintained to provide more favorable traveling conditions than in other central states. Also, the locations of nuclear facilities in relation to mines and fuel processing plants result in shipments of radioactive products and wastes across Missouri.

The railroad systems in Missouri transport voluminous types and amounts of hazardous materials on their 6,351 miles of rails that transverse the state. Though individual cars may be placarded to reveal contents such as hazardous materials, only estimates can be obtained concerning volumes of such materials, because only the interstate traffic is counted or measured. Interstate shipments are accounted for where they originate and terminate.

Increased use and transport of materials across the country has created serious problems for emergency services personnel. Many factors can increase the magnitude of an otherwise simple transportation accident into an incident of potential hazard to high numbers of people. Following are potential factors to be considered:

Over 14,000 different chemicals are estimated as being shipped by the various transportation modes.

Some types of highly toxic chemicals do not require placarding if shipped in quantities of less than 1,000 pounds, even though lesser quantities could devastate a small town.

Only a few emergency response organizations in the larger cities and counties near the more metropolitan areas have had training for handling peacetime radiological problems. Federal grants and programs provide funding for training, exercises and equipment. With state and local responders being able to utilize these resources, the general capabilities of hazardous materials response personnel and teams state wide is expected to improve. Refer to Section N – Terrorism, of this State Hazard Analysis for more information on this topic.

Other scenarios involve nuclear terrorism and faulty re-entry of nuclear-equipped satellites to earth (such as COSMOS 954 in 1978 and SKYLAB in 1980). However, transport of radioactive materials presents the most probable scenario for a radiological incident. The Department of Energy is currently shipping by truck radioactive waste to a repository in the states of Texas and Utah. These trucks cross Missouri through St. Louis and Springfield on Interstate corridors I-270 and I-44.

The federal government has finalized development of long-term repositories for spent fuel and other high-level radioactive wastes, and for transuranics (known as TRU waste), at Yucca Mountain, Nevada, and Carlsbad, New Mexico, respectively. Speculations have suggested that up to 3,600 shipments per year may go to these facilities, depending on several variables.

A large number of hazardous material shipments come from two corporations in Missouri. Covidian Medical in Maryland Heights (St. Louis County) and Tri-State Motor Transit in Joplin (Jasper County). Covidian Medical is one of the largest manufacturers of radiopharmaceuticals in the world. Tri-State is one of the largest single private carriers of radioactive materials in the world, in addition to transporting all classes of explosive materials and other toxic and hazardous materials.

Missouri is a transportation hub. The Interstate corridors of I-44, I-70 and I-55 are the most commonly used for truck transport. U.S. Highway 36 crosses the northern counties, while U.S. 60 crosses the southern counties. U.S. Highways 71, 13, 65, and 63 are also well-traveled north-south arterial routes.

Although there are railroads throughout Missouri, the UP route between St. Louis and Kansas City is the most used for large radioactive material shipments. However, the Norfolk Southern from Hannibal to Kansas City has been and is the preferred route for rail transportation of radioactive material. The switching yards at St. Louis and Kansas City, when combined, process more of these transcontinental trains than any other yards in the country.

During any radiological emergency, regardless of the cause, local officials and emergency responders will likely require state or federal support in the detection, monitoring, and analysis of radiological data for decision-making.

III. MEASURE OF PROBABILITY AND SEVERITY

A. Hazardous Materials Transportation Accident

The probability of occurrence is rated as high because of the large volume of hazardous materials being hauled over the highways and railways. This rating means that the probability of occurrence is considered sufficiently high as to assume that an event will occur at least once within any mode of transportation (including water, pipeline, and air).

The severity of the consequences is rated as moderate, but may be either low or high depending on the location of the accident and the time of day. This rating means injuries and/or death are expected only for exposed personnel over extended periods of time or when individual personal health conditions create complications.

B. Hazardous Materials Fixed Facility Accident

The probability of occurrence is rated as moderate. With the new regulations from EPA and OSHA, along with more stringent state laws and employee awareness training, this rating may be lowered to low or raised to high based on past performance. This rating means the probability of occurrence is possible during the expected lifetime of the facility.

The severity of consequences is rated as moderate but may be either low or high depending on the type and amount of chemical released. This means the chemical is expected to move into the surrounding environment at a concentration sufficient to cause serious injuries and/or death, unless prompt and effective corrective actions are taken. Injuries and/or death would be expected only for personnel exposed over an extended period or when individual personal health conditions create complications.

Note: The severity to the environment will vary in every case depending on the amount, type, and method released to determine the damage to property and the environment. Close coordination between the Missouri Department of Natural Resources, EPA, the local jurisdiction, and the spiller (responsible party) is required to ensure that potential impacts to public health and the environment are adequately addressed.

A small percentage of facilities may not be reporting activities and types of materials. If a release were to occur, the impact to public safety or environment may be more severe.

IV. IMPACT OF THE HAZARD

The entire State of Missouri is susceptible to this type of hazard, depending on a number of factors such as the following:

- Type of chemical
- Amount released/spilled
- Method of release

- Location of release
- Time of day
- Weather conditions.

This hazard could have a significant impact on the public health, the environment, or private property.

The impact of this type of disaster will likely be localized to the immediate area surrounding the incident. The initial concern will be for the people, then the environment. If contamination occurs, then the spiller is responsible for the cleanup actions and will work closely with the Missouri Department of Natural Resources, EPA, and the local jurisdiction to ensure that cleanup is done safely and in accordance with federal and state laws.

Local government (county or municipal) is more often directly impacted by radiological incidents than state or federal government. Local responders are generally the first on scene for any incident. Therefore, they have the responsibility for treating any injured victims and transporting them to a hospital for more complete medical care. Also, local first responders have the initial responsibility for controlling exposure of emergency workers and the public to any radioactive materials and to contain the spread of radioactive contamination as much as possible. While cleanup of any actual spill of radioactive materials rests with the shipper (in most cases), local responders may be required to provide site control for several hours until the responsible parties arrive on the scene.

V. SYNOPSIS

Any disaster or emergency incident could result in additional concerns when it involves of hazardous materials. For example, during the floods of 1993, a large propane tank farm in St. Louis was threatened by rising floodwaters, forcing evacuations of nearby residents in several areas. Another hazardous materials incident related to the 1993 floods involved an on-going ammonia release from the La Roche Industries, Inc., facility near Crystal City, Missouri, caused by power failure and failure of the cooling system on a large ammonia tank, ultimately resulting in off-gassing of ammonia through the tank's pressure relief check valves. The ammonia cloud over the plant led to a declaration of restricted air space in the plant vicinity for several days.

In addition, thousands of chemical containers ranging from household products and 55-gallon drums to 10,000-gallon fuel storage tanks were displaced statewide as a result of the flood damage. A Federal Disaster Declaration was issued, the National Response Framework (NFR) was implemented, and the Emergency Support Function (ESF) #10 – Hazardous Materials Annex was activated to support the statewide response to hazardous materials incidents like these and others that resulted from the flooding.

On May 22, 2011, a major tornado rated EF-5 on the Enhanced Fujita scale touched down in Joplin, Mo., killing more than 150 people, injuring hundreds of others, and destroying more than 8,000 structures in the community of nearly 50,000 residents. EPA Region 7 personnel, including On-Scene Coordinators, technical experts and other support personnel, were involved in several disaster response efforts in the Joplin area under the coordination of the Federal Emergency Management Agency (FEMA). Those efforts include responding to critical environmental emergency incidents, conducting rapid needs assessments of damaged or destroyed facilities and coordinating the removal of household hazardous wastes, white goods and e-goods from the tornado's impact zone, and conducting air monitoring for the presence of asbestos and particulate matter.

Each emergency event will need to be evaluated on an incident-specific basis, and top priority must be given to the protection of the public, then the environment, and finally property.

Tier II Forms are filed and maintained by the Missouri Emergency Response Commission (MERC) at SEMA. Site-specific plans are on file with each county's Local Emergency Planning Commission (LEPC). Transportation and evacuation routes are addressed in each county emergency operations plan.

VI. MAPS AND OTHER INFORMATION

Tier II Forms are filed and maintained by the Missouri Emergency Response Commission (MERC) at SEMA. Site-specific plans are on file with each county's Local Emergency Planning Commission (LEPC). Transportation and evacuation routes are addressed in each county emergency operations plan.

See Annex H, Figure H-2 for The Natural Gas Pipeline Map.

VII. BIBLIOGRAPHY

Past and present statistics were obtained from the following sources:

MDHSS HSEES Report, the State of Missouri Emergency Management Agency (SEMA), the Federal Highway Administration, United States Department of Energy, Center for Disease Control/Agency for Toxic Substances and Disease Registry (ATSDR), Missouri Department of Natural Resources and the Missouri Environmental Emergency Response Tracking System (MEERTS), Missouri State Highway Patrol, and the Missouri Department of Transportation.

ANNEX L

MASS TRANSPORTATION ACCIDENTS

I. TYPE OF HAZARD

Mass Transportation Accident

II. DESCRIPTION OF HAZARD

For the purpose of this study, mass transportation is defined as the means, or system, that transfers large groups of individuals from one place to another. This annex addresses only transportation accidents involving people, not materials. Thus, mass transportation accidents include public airlines, railroad passenger cars, metro rail travel, tour buses, city bus lines, school buses, riverboat casinos, and other means of public transportation.

Missouri has three major interstate highways and several other interstate highways that serve a vital role in the daily transportation needs of Missourians and the traveling public. Interstate 70 reaches across Missouri from the Illinois state line to the Kansas state line. It is the nation's fifth largest east-west corridor, passing through 10 states from Maryland to Utah. Interstate 44 stretches across the south central part of Missouri and is a major corridor traveling from the Midwest to the west coast, and Interstate 55 runs from the Midwest to the Gulf of Mexico. Missouri's 1,100-plus miles of Interstates 70, 44, 55, 64, 29 and 35 are key components of the national system providing critical Middle-America links to the national system. With this also comes the potential for larger scale motor vehicle pill-ups and commercial vehicle accidents. The Federal Motor Carrier Safety Administration reports that in 2012 there were some 12,201 Interstate Passenger Motor Carriers in the United States, many of which are probably traveling on Missouri's Interstate Highways.

The State of Missouri serves as a transportation crossroad for the United States. Missouri, being centrally located in the nation, is a natural hub for many major airlines and other types of tourist and business travel. Many cross-country travelers use Missouri terminals to connect with transport changes. Missouri has approximately 500 aviation facilities, including both public and privately owned airports, heliports, seaplane bases, and grass landing strips. Of those, approximately 140 are open to the public and 115 are publicly owned. There are eight commercial service airports served by approximately 19 scheduled airlines that transport over 20 million passengers annually. The two primary commercial service airports are Lambert St. Louis International and Kansas City International. Springfield, Joplin, Columbia, Cape Girardeau, Kirksville and Fort Leonard Wood also have commercial service.

In 1993, Missouri's largest city, St. Louis, began operating the "Metro Transit." The Metro offers three modes of transportation service, which include bus, rail, and demand-response operations, MetroBus, MetroLink, and Metro Call-A-Ride, respectively**.** In fiscal year 2012, the Metro carried 46.7 million customers and operates in a 558 square mile service area that includes the City of St. Louis and St. Louis County in Missouri, and St. Clair, Madison, and Monroe Counties in Illinois. The MetroBus system remains the largest component of the multi-modal system, operating with a fleet of 590vehicles. The MetroBus system carried approximately 29.1 million customers in 2012. MetroLink operates 87 light rail vehicles and carried 17 million customers in 2012. Light rail vehicles have a capacity of 72-seated passengers and more than 100 standing passengers. Metro Call-A-Ride has 117 vans and transported 584,291 passengers in 2012 providing transit access to customers with disabilities who are unable to use fixed-route service. Normally, the largest numbers of people are transported during the morning and evening rush hours.

Amtrak, the state's major passenger rail carrier, uses tracks that cross the entire state, from east to west. Missouri offers two round-trip daily trains between St. Louis and Kansas City with stops in Kirkwood, Washington, Hermann, Jefferson City, Sedalia, Warrensburg, Lee's Summit, and Independence. Although Amtrak has experienced a decline in passengers during this decade, it continues to carry a large number of passengers daily. The peak periods are related to holidays or special events.

Branson, Missouri, which is located close to the state's southwestern border, has become one of the state's major tourist attractions. It ranks high among the nation's top attractions serving up to 70,000 visitors daily and hosting millions of visitors annually and growing. U.S. Highway 65, a major north-south, 4-lane highway, runs through Branson providing a corridor from Minnesota to Louisiana. Southwest Missouri's primary east-west thoroughfare, Interstate 44, intersects with Highway 65 in Springfield, 35 miles north of Branson. The City of Branson recorded 75% growth during the past 10 years (2010 census), and Taney County is the 4th fastest-growing county in the State of Missouri during the 2000-2010 decade. The Springfield-Branson National Airport (SGF) is approximately 43 miles from Branson and serves all of southwest Missouri with 70 daily flights connecting to either international airports.

Because Branson is a small community, tourists are more visible there than in Kansas City or St. Louis. The City has been expanding its services (number of hospital beds, fire equipment, ambulances) and is able to provide more assistance than other small communities in the state.

With tour bus travel in the state on the increase, more bus traffic can be expected. The Passenger carrier Inspection Division of the Missouri Department of Transportation (MoDOT) has developed a comprehensive passenger carrier safety inspection program. Passenger carrier safety is a primary concern for the Division because Missouri, and especially Branson, is among the top tourist destinations in North America.

The Division has two classifications of passenger carriers: For-Hire and Private. For-hire passenger carriers provide service to the general public and are required to register with the Division. Private carriers provide passenger service in furtherance of a commercial enterprise. Examples include, but are not limited to, hotel courtesy buses, airport passenger shuttle services, buses operated by professional musicians, and buses for civic and other groups such as scout groups where no fees are collected.

The definition of a passenger carrier varies somewhat depending on whether the operation is entirely intrastate or interstate. The Federal Highway Administration's Office of Motor Carriers defines interstate passenger carrier as any vehicle designed to transport more than eight passengers, including the driver across state boundaries. The Administration's definition of intrastate includes any vehicle (not operated as a taxi or otherwise exempt) designed to transport more than six passengers, including the driver, within the state.

III. HISTORICAL STATISTICS

In 2011, commercial motor vehicles were involved in 12,796 Missouri traffic accidents. Of all Missouri traffic crashes, 9.2 percent involved a commercial motor vehicle, and of fatal traffic accidents, 15.2 percent involved a commercial motor vehicle. A total of 120 persons were killed and 3,479 were injured in commercial motor vehicle-related accidents. Commercial motor vehicles are defined as trucks having six or more tires on the power unit, buses or school buses having occupant capacities of 16 or more, and vehicles displaying hazardous materials placards.

Commercial Vehicle Accidents in Missouri 2006 - 2011

Year	Fatal Crashes	Personal Injury Crashes	Persons Killed	Persons Injured
2006	152	3,182	191	4,857
2007	148	3,232	168	5,116
2008	117	2,719	136	4,104
2009	93	2,305	103	3,573
2010	97	2,485	105	4,007
2011	108	2,309	120	3479

According to the Missouri Department of Revenue, in state fiscal year 2012 there were 11,996 registered buses in Missouri, includes all groups of buses mentioned above, to include school buses. According to the Federal Motor Carrier Safety Administration there were 3547 bus and large truck accidents in Missouri in 2012. Of that number, 145 were bus crashes (see chart below).

Federal Motor Carrier Safety Administration Data

VEHICLE TYPES	VEHICLES INVOLVED	CRASHES	FATALITIES	INJURIES
Large Trucks & Buses - 2011	3922	3718	108	2013
Large Trucks & Buses - 2012	3547	3373	108	2067
Large Trucks & Buses – 2013*	1536	1468	35	793
Large Trucks - 2011	3515	3332	104	1580
Large Trucks - 2012	3132	2984	99	1465
Large Trucks – 2013*	1390	1326	34	587
Buses – 2011	407	401	4	502
Buses – 2012	415	405	9	617
Buses – 2013*	146	145	1	209

* (Numbers reflect data from 1-1-13 to 6-30-13)

IV. MEASURE OF PROBABILITY AND SEVERITY

On May 22, 1962, the first commercial jet airliner to be sabotaged crashed near Unionville, Missouri. The Continental 11, carrying 45 people (37 passengers and 8-crew) crashed, taking the lives of everyone aboard. Upon investigation, it was discovered that a dynamite bomb hidden in a towel container under the washbasin in the right rear lavatory detonated. The blast caused the plane's tail to break away from the rest of the fuselage and the aircraft to go out of control. Responsibility for this crash was blamed on a passenger, Thomas Doty, a 34-year old from Kansas City. Doty had been recently arrested for armed robbery and was to soon face a preliminary hearing in the matter. Investigators determined that Doty had purchased six sticks of dynamite for 29 cents each, shortly before the crash, and authorities were able to deduce that a bomb had been placed in the towel bin. This event exemplifies the hazard that exists for any mass transportation system in Missouri.

Another example occurred in January of 2008, when a 56-passenger bus carrying 52 passengers on a rural segment of US highway in Southeastern Utah departed the road and rolled, ejecting 50 of the passengers as the roof of the motor coach sheared off. Seven passengers were fatally injured and died at the scene; two others died en route to hospitals. The driver and 34 passengers were seriously injured. Air medical helicopters could not respond due to weather and the closest Level 1 trauma center was 190 miles away. Twenty ambulances ultimately responded, two of which were from 230 miles away, making it a very difficult mass casualty incident to manage. According to the National Transportation Safety Board Highway Board, an average of 137 large buses crash in the U.S. each year with one or more resulting fatalities, and almost 75% of the people injured in those crashes required transport to a hospital.

A major accident can occur at any time, even though all safety precautions are in place. Based on the latest available information, the probability and severity of a mass transportation accident are both rated as moderate.

V. IMPACT OF THE HAZARD

Any large scale mass transportation accident could burden a local jurisdiction's available medical services, and response personnel To minimize this problem, mutual aid agreements with adjoining jurisdictions should be developed between ambulance services and the hospitals, and other response agencies. This type of hazard could involve hazardous materials or a fire, which would compound the impacts of the incident. Severe weather could also hamper response efforts.

VI. SYNOPSIS

The State of Missouri serves as a transportation crossroad for the United States. Missouri, being centrally located in the nation, is a natural hub for many major airlines and other types of tourist and business travel. Many cross-country travelers use Missouri terminals to connect with transport changes. Mass transportation includes public airlines, railroad passenger cars, metro rail travel, tour buses, city bus lines, school buses, riverboat casinos, and other means of public transportation. Missouri has many aviation facilities --with the two primary commercial service airports, Lambert St. Louis International and Kansas City International. Due to increased tourism in Branson, Missouri, for-hire passenger carriers, such as tour buses, have increased. Other considerations are hotel courtesy buses, airport passenger shuttle services, buses operated by professional musicians, and buses for civic and other groups such as scout groups where no fees are collected. Along with Amtrak, the state's major passenger rail carrier, the St. Louis Metro Transportation System offers bus, rail, and demand-response operations. Mass transportation in Missouri is expanding due to increased tourism, rising fuel costs, and the availability and convenience it provides. Many deaths occur as a result of mass transit accidents emphasizing the need for continued and enhanced response capabilities.

VII. MAPS OR OTHER ATTACHMENTS

Please refer to Missouri Highway Patrol's Missouri Traffic Safety Compendium (call 573-751-9000, ext. 2299 or access their website at:
http://www.mshp.dps.missouri.gov/MSHPWeb/SAC/pdf/missouri2011TrafficSafetyCompendium.pdf

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ANNEX M

CIVIL DISORDER

I. TYPE OF HAZARD

Civil Disorder (Riots, Protests, Sit-Ins, Marches, Demonstrations)

II. DESCRIPTION OF HAZARD

Civil disorder is a term that generally refers to groups of people purposely choosing not to observe a law, regulation, or rule, usually in order to bring attention to their cause, concern, or agenda. In Missouri, state statutes define civil disorder as "any public disturbance involving acts of violence by assemblages of three or more persons, which cause an immediate danger of or results in damage or injury to the property or person of any other individual."

Civil disorders can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. In the 1990s, abortion clinics, for example, were targets for these disruptive-type activities.

Throughout this country's history, incidents that disrupted the public peace have figured prominently. The Constitutional guarantees allow for ample expression of protest and dissent, and in many cases collide with the Preamble's requirement of the government "to ensure domestic tranquility." Typical examples of such conflicting ideology include the protest movements for civil rights in the late 1960s, and the Vietnam War protest demonstrations in the mid-1970s. The balance between an individual's or group's legitimate expression of dissent and the right of the populace to live in domestic tranquility requires the diligent efforts of everyone to avoid such confrontations in the future.

In modern society, laws have evolved that govern the interaction of its members to peacefully resolve conflict. In the United States, a crowd itself is constitutionally protected under "the right of the people to peacefully assemble." However, assemblies that are not peaceable ***are not protected,*** and this is generally the dividing line between crowds and mobs. The laws that deal with disruptive conduct are generally grouped into offenses that disturb the public peace. They range from misdemeanors such as blocking sidewalks or challenging another to fight, to felonies such as looting and rioting. Missouri law makes "promoting civil disorder in the first degree" a class C felony, according to Section 574.070 of the Revised Missouri Statutes. As stated in one provision of the law, "Whoever teaches or demonstrates to any other person the use, application, or construction of any firearm, explosive, or incendiary device capable of causing injury or death to any person, knowing or intending that such firearm, explosive or incendiary device be used in furtherance of a civil disorder, is guilty of promoting civil disorder in the first degree."

A. Types of Crowds and Mobs

1. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four general categories:

   a. Casual Crowd—A casual crowd is merely a group of people who happen to be in the same place at the same time. Examples of this type include shoppers and sightseers. The likelihood of violent conduct is all but nonexistent.
   b. Cohesive Crowd—A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity such as worshiping, dancing, or watching a sporting event. Although they may have intense internal discipline (e.g. rooting for a team), they require substantial provocation to arouse to action.
   c. Expressive Crowd—An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest something.
   d. Aggressive Crowd—An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They tend to be impulsive and highly emotional and require only minimal stimulation to arouse them to violence. Examples of this type of crowd include demonstrations and strikers.

2. A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent, and lawless. Like crowds, mobs have different levels of commitment and can be classified into four categories:

   a. Aggressive Mob—An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.

   b. Escape Mob—An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs have lost their capacity to reason and are generally impossible to control. They are characterized by unreasonable terror.

   c. Acquisitive Mob—An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property. Examples of acquisitive mobs would include the looting in South Central Los Angeles in 1992, or food riots in other countries.

d. Expressive Mob—An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations. Examples of this type of mob include the June 1994 riots in Canada following the Stanley Cup professional hockey championship, European soccer riots, and those occurring after other sporting events in many countries, including the United States.

Although members of mobs have differing levels of commitment, as a group they are far more committed than members of a crowd. As such, a "mob mentality" sets in, which creates a cohesiveness and sense of purpose that is lacking in crowds. Thus, any strategy that causes individual members to contemplate their personal actions will tend to be more effective than treating an entire mob as a single entity.

III. HISTORICAL STATISTICS

A. Missouri

Fortunately, Missouri has not experienced a trend of consistent riotous behavior or disruptive civil disorder, as some other states have witnessed in the past several decades. While far from recent, Missouri's most notable incident is the famous 1954 prison riot in Jefferson City, which stands as the state's worst-case example of a full-scale riot. Other events in Missouri's early history, as well as those in the late 1960s through this decade, indicate the state is not immune to riots, protests, and social upheaval, but no event caused the destruction that occurred during the 1954 prison riot. Some brief examples of Missouri's riotous events are provided below.

1. In the spring of 1832, citizens in Jackson County began to show their hostility toward Mormon newcomers by stoning their houses. In July 1833, a public meeting to determine the Mormon question resulted in demands that no more Mormons be allowed to settle there, that Mormons already residing in the county move out immediately, and that the Mormon newspaper (the Evening and Morning Star) be suspended. When the Mormon settlers refused these demands, the citizens razed the newspaper office, threw the press in the Missouri River, and tarred and feathered two Mormons. The Mormons appealed their plight to Governor Daniel Dunking, who issued a decision denying any citizen the right to take into his own hands the redress of grievances. He recommended that the Mormons take their case to civil courts to uphold their rights. Incensed by this action, about 50 armed men attacked a Mormon settlement called Big Blue near Independence on October 31, 1833, beating several of the men and destroying 10 homes. Hostilities continued the next two nights. On November 4, a band of citizens fought about 30 Mormons at Big Blue; three citizens, including one Mormon, were killed. Feeling they were outnumbered, most of the Mormons left the county as a result. The few who remained eventually left as well due to continued threats and hostilities.

2. In 1906 on the night before Easter Sunday in Springfield, a mob of 6,000, fueled by alcohol and rumors of a white woman's rape, battered down the jailhouse doors and carried away three black men who were then hanged in the town square. Within hours, new rumors spread that black neighborhoods were about to be destroyed. Hundreds of black people fled before the state militia arrived to

restore order. In the months that followed, a grand jury indicted more than a dozen people for the hangings, and the story of the woman's attack proved to be untrue. Only one person went to trial, however, and the jury deadlocked without reaching a verdict. In her book about the incident and its aftermath, "Many Thousand Gone," Katherine Lederer notes that until 1906, Springfield had a thriving black population, but the population has never recovered.

3. On September 22, 1954, a full-scale riot broke out at the Men's State Penitentiary in Jefferson City at about 6 p.m., after an inmate released several prisoners. The inmate had obtained keys from a guard by a ruse. At 7:00 p.m., all available state highway patrolmen were directed to report to the penitentiary as quickly as possible to quell the riot. Several buildings and vehicles were burning at that time, and some 500 inmates were loose, hurling bricks, yelling, and attempting. Both chapels were ablaze, as well as several prison shops and factories. Seeing the fires, which were visible at dusk from about 20 miles away, prisoners at the Algoa reformatory and the women's prison staged separate rebellions there. Damage to state property at those facilities was minimal, but at the main prison, only cell houses and buildings equipped with sprinklers survived. By 11:30 p.m., 285 patrolmen in 202 cars were on the scene, and by midnight, some 100 St. Louis policemen carrying submachine guns had arrived by special train. They surrounded cell houses B and C—the only halls in which guards were still held hostage. Highway patrolmen and arriving National Guardsmen took positions on rooftops overlooking the quadrangle—a yard between the larger cell houses. From that vantage point, they opened fire, seriously wounding many inmates in the exchange. Shortly after 7 a.m. the next day, the last guard taken hostage was released, and the rioters, having no alternative, gave up shortly thereafter. By mid-morning, 2,000 police officers and National Guardsmen were on duty at the prison. When the riot was finally over, three inmates had been killed, and 21 wounded by gunfire. One other prisoner was murdered by stabbing and beating, and eight others were injured in fighting with each other. Five buildings were completely destroyed, and two others partially destroyed, resulting in more than $10 million in losses to state property.

4. On October 23, 1954, another riot occurred at the State Penitentiary while state troopers were still technically operating the institution. This melee was between white and black inmates, starting over food. Bricks began to fly, followed by gunfire from the troopers. Approximately 35 prisoners were wounded in that incident.

5. On the evening of March 19, 1958, at Algoa Intermediate Reformatory, east of Jefferson City, quick action by then Governor James T. Blair and a contingent of state highway patrolmen with riot guns quelled a potential inmate uprising. The governor himself and the patrolmen entered the facility amid reports of unrest following the resignation of the institution's acting superintendent. When no trouble occurred, the troopers were removed after about 2 hours.

6. On April 9, 1968, the Kansas City Police Department requested the help of the Missouri Highway Patrol in quelling rioting, bombing, and looting in the eastern part of the city in the wake of the Martin Luther King assassination. Over 200 officers reported to the staging area at District Four of the State Highway

Department to receive their assignments, and began patrolling the downtown area.

Officers arrested numerous persons for charges ranging from curfew violations to felonious assault. They remained on duty for 10 days until peace was restored.

7. Twice in May 1969, demonstrations at Lincoln University in Jefferson City resulted in about 200 highway patrolmen being called to the scene to combat arson, sniper fire, and vandalism on campus. The Student Union was burned during those demonstrations.

8. On February 17, 1975, at Algoa Intermediate Reformatory, a minor riot broke out, resulting in tear gas being thrown into dormitories at the institution. Three prison officials suffered minor injuries, and one inmate required stitches to close a wound. The incident resulted in about $5,000 in property damage.

9. In December 1977 and January 1978 in Southeast Missouri, farmers making up an American Agricultural Movement staged demonstrations to protest what they felt were unfair prices for their products, as maintained by government price supports. The rallies continued through April 1978, with picketing, tractorcades, and stoppage of highway traffic throughout the area, despite high winds, ice, and snow. More than 300 farm tractors were involved in at least one of these actions. On January 11th, highway patrol troopers on Interstate 55 (I-5 5) near Hayti arrested seven farmers and charged them with failure to obey a reasonable request, assault, and damaging state property. Four others were arrested on I-55 near Caruthersville for driving their pickup trucks slowly side by side, preventing traffic from passing. Twenty-five farmers with their tractors were involved in a fracas with 12 officers near Hayti. Two patrol cars were damaged, and one officer sustained minor injuries when shoved by an irate farmer into the path of a road grader.

10. On April 29, 1992, in Warrensburg, racial tensions mounted following the announcement of the controversial Rodney King verdict. The Johnson County Emergency Operations Center was activated for several hours as police remained on alert status for a potential serious disturbance. Military police from nearby Whitman Air Force Base were also placed on standby alert status, but no major problems occurred.

B. United States

1. Incidents of civil disorder that erupted into violence are part of American history, spanning several centuries. In March 1770, just prior to the Revolutionary War, a riot occurred when Boston citizens jeered and taunted British soldiers and began throwing things at them during a demonstration. Five people were killed when the troops fired during the incident, which became known as “The Boston Massacre.” Three years later, on December 16, 1773, a group of Boston citizens protested the British tax on tea to the colonies by throwing it overboard. The “Boston Tea Party” was a harbinger of troubles that eventually led to the Revolutionary War.

2. On May 4, 1886, another violent event occurred in Haymarket Square in Chicago when a confrontation took place between police and strikers at the McCormick reaper works. A bomb was thrown and a gun battle erupted, during which seven police officers and four workers were killed. Many police and civilians were also injured in what became known as the "Haymarket Square Riot."

3. Controversy over civil rights and the unpopular war in Vietnam during the 1960s and 1970s resulted in one of the most turbulent periods in American history. During this same time, major riots occurred in Los Angeles in 1965; Detroit in 1967; Chicago in 1968 during the Democratic National Convention; Santa Barbara, California, in 1970; East Los Angeles, California, in 1970 and 1971; and Attica, New York, in 1971, during a major prison riot. Violent rioting once again erupted across the country on April 29, 1992, when four police officers were acquitted after being accused of beating a black suspect (Rodney King). Also in recent years, issues such as abortion, gay rights, immigration, and gun control have generated great public debate and resulted in many mass assemblies and demonstrations.

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Probability

1. Across the nation, police reports reflect a fairly steady rate of theft, mugging, arson, and homicide incidents. But these criminal acts do not amount to "riots." In their article on "Understanding Riots" published in the Cato Journal (Vol. 14, No 1), David D. Haddock and Daniel D. Polsby note that a large crowd itself is not an incipient riot merely because it assembles a great many people. Haddock and Polsby explain that "starting signals" must occur for civil disorder to erupt; these starting signals include certain kinds of high profile events. In fact, incidents can become signals simply because they have been signals in the past. In Detroit, for example, Devils Night (the night before Halloween) has in recent years become a springboard for multiple, independent, and almost simultaneous acts of arson. With any conventional triggering event, such as news of an assassination or unpopular jury verdict, crowds form spontaneously in various places as word of the incident spreads, without any one person having to recruit them. But since not every crowd threatens to evolve into a riot, the authors reason that a significant number of people must expect and desire that the crowd will become riotous. In addition, "someone has to serve as a catalyst – a sort of entrepreneur to get things going." A typical action is the breaking of a window (a signal that can be heard by many who do not necessarily see it). Someone will throw the first stone, so to speak, when he calculates the risk of being apprehended has diminished to an acceptable level. This diminished risk is generally based on two variables – the size of the crowd relative to the police force and the probability that others will follow if someone leads. The authors conclude that once someone has taken a risk to get things started, the rioting will begin and spread until civil authorities muster enough force to make rioters believe they face a realistic prospect of arrest.

2. Nationwide, riots are apt to be a recurrent, if unpredictable, feature of social life. Without question, Missouri will continue to experience future episodes of

marches, protests, demonstrations, and gatherings in various cities and communities that could lead to some type of disruptive civil disorder. However, based on the state's general history of civil disturbance and the various human factors noted above, the probability that such incidents will develop into full-scale riots is considered low.

3. Regarding penal institutions, much has been done in Missouri and other states to alleviate living conditions, which are underlying factors in many riots (prison overcrowding, poor treatment of inmates, lack of grievance procedures, etc.). The State has been building new prisons for several years, or expanding facilities to create more space and otherwise improve its facilities for its inmate population. As of July201231,247nmates were housed in 21 state correctional centers. A map of the correctional institutions and probation and parole offices in the state is provided as Figure M- 1. One federal prison is located in the state, in Springfield.

B. Severity

Should Missouri experience future incidents of disruptive civil disorder or rioting, the severity of a given event could range from low to high, depending on many factors. A spirited demonstration that gets out of hand may result in several arrests, minor damage to property (police vehicles with broken windows, etc.), some injuries, and manpower/overtime costs for police, fire, and other response services. To a greater extent, the threat of urban or intercity riots has the potential for millions of dollars in property damage, possible loss of life and serious injuries, and extensive arrests. Sustaining police at the scene for extended periods, and possibly mobilizing state highway patrol and National Guard units, can add to the extensive manpower costs. Still, such riots tend to be confined to a single site or general area of a community rather than multiple locations or several areas of the state at the same time. Once a riot has occurred, police in other cities are generally on standby for possible riotous conditions and are better able to alleviate potential disturbances before they develop into full-scale riot events.

V. IMPACT OF THE HAZARD

When rioting does break out, it generally proves extremely difficult for first-responder law enforcement authorities to quell the mob promptly. The rules of Constitutional law set stringent limits on how police officers can behave toward those whom they try to arrest. Restraint also plays a crucial part in avoiding any action that "fans the flames." Initial police presence is often undermined because forces may be staffed below the peak loads needed to bring things back under control. As a result, the riot may continue until enough state police or National Guard units arrive to bolster the arrest process and subsequently restore order. In many cases, damage to lives and property may already be extensive.

VI. SYNOPSIS

In the wake of numerous urban riots in the late 1 960s and beyond, a unique approach in law enforcement began to emerge as a viable means to reduce the risk of such future riots. Known as "Community Policing," its philosophy rests on the belief that reducing and controlling serious crime requires the police to pay renewed attention to all problems that allow serious crime to occur. In its comprehensive report following the devastating 1967 Detroit riot for example, the Kerner Commission noted that police "cannot, and should not, resist becoming involved in community service matters." The benefits to law enforcement and public order, the Commission says, include the following:

A. Because of their "front-line position" in dealing with ghetto problems, police will be better able to identify problems in their community that may lead to disorder.

B. They will be better able to handle incidents requiring police intervention.

C. Willing performance of such work can gain police the respect and support of the community.

D. Development of non-adversary contacts can provide the police with a vital source of information and intelligence concerning the communities they serve.

E. In his paper entitled "Preventing Civil Disturbances: A Community Policing Approach," Michigan State University professor Robert C. Trojanowicz says Community Policing can reduce the potential for riots beyond simply reducing racial tensions between the police and the black community. The organizational strategy of community policing, he writes, "requires freeing some police officers from the isolation of the patrol car, so they can work directly in the community and enlist them as partners in the process of policing themselves. It addresses the need that everyone in the U.S. deserves to live in a safe and stable community, free of drugs and violence, and reminds us that "until we are all safe, no one is safe." Four basic ways community policing can help in riot prevention, the author says, are as follows:

1. It provides a means of gathering superior intelligence that allows us to identify areas at risk, the level of threat in those areas, and weaknesses and strengths within the community.
2. It provides the police with a way to address those weaknesses, which often include crime, violence, drugs, fear of crime, disorder, neighborhood decay, and juveniles at risk.
3. It reaches out to law-abiding people in the community and involves them in the police process, serving as the vital link required to enlist their help in actively promoting order and stability.

It reduces the overall risk to riots by improving the relations between the police and the black community.

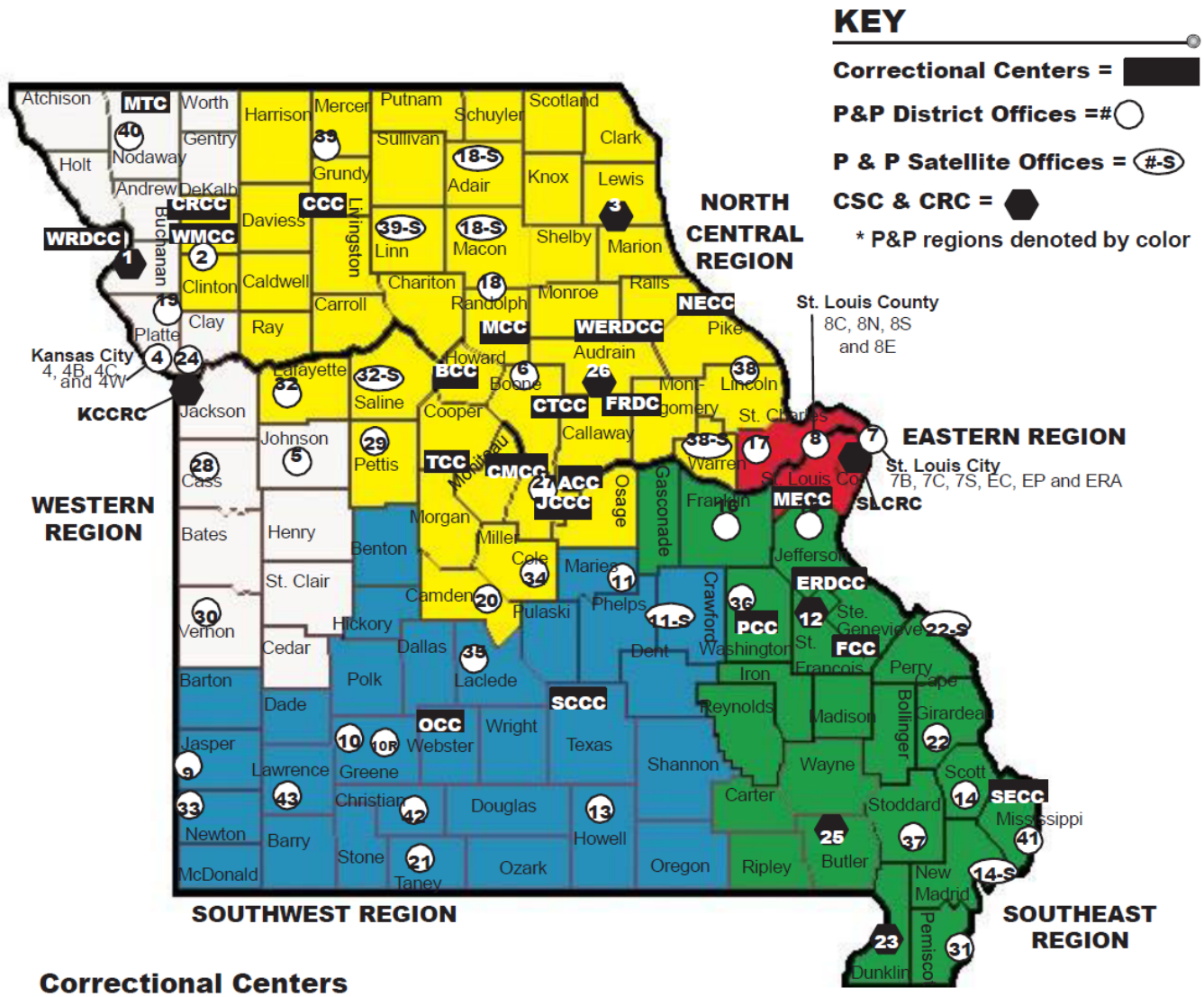
A COMMUNITY POLICING OFFICER (CPO), THE AUTHOR NOTES, IS A FULL-FLEDGED LAW ENFORCEMENT OFFICER WHO MAKES ARRESTS, BUT IS FURTHER CHALLENGED TO FIND NEW WAYS TO ADDRESS OLD PROBLEMS. CPOS ACT AS COMMUNITY ADVOCATES FOR NEEDED NEIGHBORHOOD SERVICES (PROMPT TRASH PICKUP, DEMOLITION OF ABANDONED BUILDINGS, ETC.) AND SERVE AS COMMUNITY LIAISON TO PUBLIC AND PRIVATE AGENCIES, TROJANOWICZ WRITES. "THIS CAN MEAN LINKING TROUBLED FAMILIES TO AFFORDABLE COUNSELING SERVICES, LINKING THE HOMELESS TO SHELTER, OR TAPPING LOCAL BUSINESS TO PROVIDE DONATED SUPPLIES FOR PROJECTS TO BEAUTIFY THE AREA." THE INITIATIVES ARE BOUNDED ONLY BY THE COLLECTIVE IMAGINATION OF THE CPO AND THE PEOPLE IN THE COMMUNITY AND THEIR LOCAL NEEDS, THE AUTHOR CONCLUDES.

VII. MAPS OR OTHER ATTACHMENTS

A map identifying Correctional Institutions and Probation & Parole Offices is attached as Figure M- 1.

Figure M-1

Correctional Institutions and Probation & Parole Offices



Correctional Centers & Institutional Parole Region

ACC - Algoa Correctional Center, Jefferson City
BCC - Boonville Correctional Center, Boonville
CMCC - Central Missouri Correctional Center, Jefferson City (closed)
CCC - Chillicothe Correctional Center, Chillicothe
CRCC - Crossroads Correctional Center, Cameron
ERDCC - Eastern Reception, Diagnostic & Correctional Center, Bonne Terre
FCC - Farmington Correctional Center, Farmington
FRDC - Fulton Reception & Diagnostic Center, Fulton
CTCC - Cremer Therapeutic Community Center, Fulton
JCCC - Jefferson City Correctional Center, Jefferson City
MTC - Maryville Treatment Center, Maryville
MECC - Missouri Eastern Correctional Center, Pacific
MCC - Moberly Correctional Center, Moberly
NECC - Northeast Correctional Center, Bowling Green
OCC - Ozark Correctional Center, Fordland
PCC - Potosi Correctional Center, Potosi
SCCC - South Central Correctional Center, Licking
SECC - Southeast Correctional Center, Charleston
TCC - Tipton Correctional Center, Tipton
WMCC - Western Missouri Correctional Center, Cameron
WRDCC - Western Reception, Diagnostic & Correctional Center, St. Joseph
WERDCC - Women's Eastern Reception, Diagnostic & Correctional Center, Vandalia

Probation and Parole District Offices

1. St. Joseph Community Supervision Center (CSC)
2. Cameron
3. Hannibal Community Supervision Center (CSC)
4. Kansas City (4 offices)
5. Warrensburg
6. Columbia
7. St. Louis City (6 offices)
8. St. Louis County (4 offices)
9. Joplin
10. Springfield (2 offices)
11. Rolla (Steelville Satellite)
12. Farmington Community Supervision Center (CSC)
13. West Plains
14. Sikeston (New Madrid Satellite)
15. Hillsboro
16. Union
17. St. Charles
18. Moberly (Macon and Kirksville Satellites)
19. Liberty
20. Camdenton
21. Branson
22. Cape Girardeau (Perryville Satellite)
23. Kennett Community Supervision Center (CSC)
24. Independence
25. Poplar Bluff Community Supervision Center (CSC)
26. Fulton Community Supervision Center (CSC)
27. Jefferson City
28. Belton
29. Sedalia
30. Nevada
31. Caruthersville
32. Lexington (Marshall Satellite)
33. Neosho
34. Lake Ozark
35. Lebanon
36. Potosi
37. Dexter
38. Troy (Warrenton Satellite)
39. Trenton (Brookfield Satellite)
40. Maryville
41. Charleston
42. Nixa
43. Aurora

KCCRC: Kansas City Community Release Center (CRC)
SLCRC: St. Louis Community Release Center (CRC)

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ANNEX N

TERRORISM

I. TYPE OF HAZARD

Terrorism

II. DESCRIPTION OF HAZARD

Terrorism, as defined by the Federal Bureau of Investigation (FBI), is: "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." The effects of terrorism can vary significantly, including loss of life, injuries to people and properties, and disruptions in services (e.g., water supplies, public transportation, and communications). According to the FBI, there are two primary types of terrorism:

- Domestic Terrorism—involves groups or individuals whose terrorist activities are directed at elements of our government or populations without foreign direction.

- International Terrorism—involves terrorist activity committed by groups or individuals who are foreign-based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries.

III. HISTORICAL STATISTICS

A. Terrorism Incidents in the U.S.

The following section highlights selected terrorist-related threats and actual attacks that have occurred in the United States since 1995 providing insight into the variety and diversity of terrorists and terrorists groups.

- In April 1995, a massive bomb exploded inside a rental truck parked near the Alfred P. Murrah Federal Building in Oklahoma City, destroying half the nine-story building and killing 168 people. The incident was traced to Timothy McVeigh, who was convicted of the bombing and later executed by lethal injection. McVeigh was a survivalist who believed individual rights were being deprived by government agencies. He was convinced he acted to defend the Constitution and saw himself as a crusader and hero. At the time, this was the worst terrorist event, either domestic or international, that had ever occurred in the United States.

- In October 1995, the Amtrak Sunset Limited passenger train derailed near Hyder, Arizona. It was determined that the train track had been sabotaged, causing the train to derail and topple 30 feet from a bridge. A letter signed by the Sons of Gestapo was left at the scene. One person was killed and 83 others were injured in this incident.

- In November 1995, members of the Tri-States Militia (a group composed of militia from at least 30 states) were arrested after being linked to five would-be terrorists whose bomb plots were thwarted by federal and state law enforcement agencies. The plots involved blowing up the Southern Poverty Law Center, offices of the Anti-Defamation League, federal buildings, abortion clinics, and gay community locations.

- In July 1996, a pipe bomb exploded in Atlanta's Centennial Olympic Park as the city was hosting the summer Olympic Games. One person was killed and dozens were wounded. It was later determined the bomb had been planted by Eric Robert Rudolph, who was also suspected of being responsible for a double bombing at the Sandy Springs Professional Building in Atlanta in January 1997 and a double bombing at The Otherside Lounge in Atlanta in February 1997. Rudolph was arrested in May 2003; he is a former soldier and survivalist with extreme right-wing views and is also reported to have ties to white supremacist groups.

- On September 11, 2001, there were a series of coordinated terrorist suicide attacks by Islamic extremists upon the United States. Nineteen terrorists affiliated with al-Qa'ida hijacked four commercial passenger jet airliners. Each team of hijackers included a trained pilot. The hijackers intentionally crashed two of the airliners into the World Trade Center (WTC) in New York City, one plane into each tower, resulting in the collapse of both buildings soon afterward and extensive damage to nearby buildings. The hijackers crashed a third airliner into the Pentagon in Arlington County, Virginia, near Washington, D.C. Passengers and members of the flight crew on the fourth aircraft attempted to retake control of their plane from the hijackers; that plane crashed into a field near the town of Shanksville in rural Somerset County, Pennsylvania. In addition to the 19 hijackers, 2,974 people died as an immediate result of the attacks, and the death of at least one person from lung disease was ruled by a medical examiner to be a result of exposure to WTC dust. Another 24 people are missing and presumed dead. The victims were predominantly civilians. The New York City Fire Department lost 341 firefighters and 2 paramedics, while 23 New York Police Department officers, 37 Port Authority Police Department officers, and 8 private ambulance personnel were killed. There were 125 victims in the Pentagon. The attacks created widespread confusion across the United States. All international civilian air traffic was banned from landing on United States soil for three days and unconfirmed and often contradictory reports were aired and published throughout the day.

- Between early October and early December 2001, five people died from anthrax infection, and at least 13 others contracted the disease in Washington, D.C.; New York City; Trenton, New Jersey; and Boca Raton, Florida. Anthrax spores were found in a number of government buildings and postal facilities. Most of the confirmed anthrax

cases were tied to contaminated letters mailed to media personalities and U.S. Senators. Thousands of people were potentially exposed to the spores and took preventive antibiotics. Numerous mail facilities and government buildings were shut down for investigation and decontamination. In the wake of these incidents, federal, state, and local emergency response agencies across the United States responded to thousands of calls to investigate suspicious packages, unknown powders, and other suspected exposures. Almost all of these incidents turned out to involve no actual biohazard. Nevertheless, emergency responders typically treated each call as a potentially serious health and safety risk. During this time in Missouri, the Department of Health and Senior Services (DHSS) issued numerous Health Alert Advisories to local officials and the public, providing guidance on how to handle anthrax or other suspicious letters and packages. DHSS also instituted a surveillance system, contacting health providers to obtain public health information twice weekly, while also working to improve the public health infrastructure, information sharing, health communication networks, and hospital surge capabilities.

- Between March 2002 and November 2002, a series of animal rights and ecoterrorism incidents occurred in Erie, Harborcreek, and Warren, Pennsylvania. On March 18, 2002, Pennsylvania State Police discovered heavy equipment used to clear trees at a construction site in Erie, Pennsylvania, spray painted with the statements "ELF, in the protection of mother earth," and "Stop Deforestation." On March 24, 2002, police responded to the same construction site, where a large hydraulic crane had been set on fire, causing approximately $500,000 in damage

- On August 22, 2002, police in Pinellas County, Florida, responding to a domestic dispute detained Robert J. Goldstein after finding numerous weapons and explosives and a "mission statement" threatening to attack Islamic facilities in the United States. Goldstein was later arrested and charged with weapons violations and an attempt to destroy property. Michael Wallace Hardee, Samuel V. Shannahan III, and Goldstein's wife, Kristi Goldstein, were also arrested and charged in connection with the plot. An investigation revealed that the intended target of Goldstein's planned attack was the Islamic Center of Pinellas County, in Pinellas Park, Florida, and that the attack had been planned to coincide with the first anniversary of the September 11, 2001, terrorist attacks.

- On February 13, 2003, law enforcement officials arrested David Wayne Hull, a long-time member and self-professed leader of the White Knights of the Ku Klux Klan (KKK). Hull had been exploding pipe bombs on his property in Amwell Township, Pennsylvania, had built and detonated improvised explosive devices (IEDs) during KKK events, and was recorded instructing individuals on how to place IEDs to cause maximum damage. Hull had also made threats against minorities and abortion clinics.

- On April 4, 2003, the FBI arrested David Roland Hinkson, a constitutionalist and tax protestor, for attempting to arrange the murders of a federal judge, an Assistant U.S. Attorney, and an IRS Agent whom he blamed for his legal problems regarding a tax evasion case against him. Between December 2002 and March 2003, Hinkson offered two individuals $10,000 for committing all three murders.

- On August 1, 2003, the San Diego Fire Department and San Diego Police Department responded to an arson fire at the Garden Condominium, a five-story, 206-unit condominium complex under construction in the University Town Center area of San Diego. The fire caused an estimated $20 million in damages to the building and surrounding construction equipment. Investigators found graffiti at the site implicating Earth Liberation Front (ELF) extremists with the incident, including the message "IF YOU BUILD IT – WE WILL BURN IT. THE ELF'S ARE MAD."

- On November 11, 2003, Stephen John Jordi was arrested in Miami, Florida, for plotting to attack several abortion clinics. Jordi had openly discussed his intentions to attack abortion clinics, had expressed solidarity with anti-abortion extremists, and had associated with individuals from the anti-abortion extremist group Army of God. Jordi set out potential targets and a specific time frame for the attacks, and had cased and videotaped numerous Miami-area abortion clinics. He had also purchased several items to carry out the attack, including containers of gasoline and propane, flares, starting fluid, and a silencer purchased from an FBI source.

- The FBI arrested Sean Michael Gillespie on April 16, 2004, for having firebombed the Temple B'nai Israel in Oklahoma City, Oklahoma. The attack against the synagogue in Oklahoma City was likely the first of a series of unspecified attacks Gillespie intended to commit. Following Gillespie's arrest, a search of his residence revealed a videotape containing surveillance of a Las Vegas synagogue and a statement by Gillespie that he was on a "mission for the white race," which was to involve a cross-country spree of unspecified terrorist acts.

- On May 6, 2004, several extremist members of the Project 7 Militia were arrested following an extensive investigation into the group by FBI, Bureau of Alcohol, Tobacco, and Firearms, and local police. Investigation had identified leader David Burgert and five other members of the Project 7 Militia as having committed various violations of federal law in furtherance of violent plans targeting law enforcement officers and other government officials.

- On August 8, 2005, Carlos Gamarra-Murillo was sentenced in United States District Court in Tampa, Florida, to 25 years imprisonment for brokering and exporting defense articles without a license and providing material support to a foreign terrorist

organization. Gamarra-Murillo attempted to supply the Colombian-based FARC with 4,000 grenades and 200 firearms.

- On December 5, 2005, Michael Curtis Reynolds was arrested at a motel near Pocatello, Idaho, after arranging to meet a purported al-Qa'ida contact. Reynolds offered to assist al-Qa'ida in engaging in acts of terrorism within the United States by identifying targets, planning terrorist attacks, and describing bomb-making methods. Reynolds sought to carry out violent attacks against pipeline systems and energy facilities in an effort to reduce energy reserves, create environmental hazards, and increase anxiety. Reynolds sought payment for supplying his assistance and continuing work on behalf of al-Qa'ida.

- On May 20, 2010 a routine traffic stop in Arkansas turned into a violent shooting between police and a father-son pair of sovereign citizens. Police stopped a minivan in West Memphis, Arkansas, setting off a chain of events that would result in the deaths of two officers as well as Jerry Kane and his 16-year-old son Joseph Kane. Both Kanes were deeply immersed in the anti-government movement known as sovereign citizens. Sovereign citizens frequently have encounters with law enforcement and confrontations may escalate to violence.

- A Fairbanks, Alaska group known as the Alaska Peacemakers Militia was accused of conspiring to kill a judge, an IRS agent, and an Alaska State Trooper. Members were charged with conspiracy to murder a federal judge and an IRS employee and various weapons charges.

B. Forms of Terrorism

Terrorism can take place in various forms, depending on the technological means available to the terrorist group or individual, the nature of the issue motivating the attack, and the points of weakness of the target. Potential terrorist actions include:

- Bombings - Bombings have long been used in terrorist attacks, and probably represent the most "traditional" form of terrorism. These types of incidents range from small-scale letter bombs to large-scale attacks on specific buildings. Other bomb-related incidents frequently involve "suicide bombers," who sacrifice themselves for their cause.

- Airline Attacks - In the past, terrorist acts involving aircrafts were generally restricted to hijackings and bombings. However, the attacks on the World Trade Center buildings in New York City in 2001 brought a new avenue to light – the use of commercial aircraft to attack infrastructure targets. Surface-to-air missile attacks also present a threat to aircraft.

- Weapons of Mass Destruction (WMD) Attacks - WMD attacks usually involve nuclear weapons or biological or chemical agents. Chemical and biological agents are infectious microbes or toxins used to produce illness or death. They can be dispersed as aerosols or airborne particles directly onto a population, producing an immediate or a delayed effect. Severity of injuries depends on the type and amount of the agent used and duration of exposure.

- Infrastructure Attacks - These types of attacks can impact various potential targets including: water distribution systems and treatment plants, utility companies and services, emergency services, gas and oil production facilities, telecommunications centers, transportation terminals, media facilities, government buildings, and religious institutions.

- Cyber-Terrorism - Pertains to attacks on computer-based systems that are designed to spread disinformation and propaganda, deny service to legitimate computer users, spread electronic viruses to corrupt vital data, or cause critical infrastructure outages.

- Agro-Terrorism - Involves intentional contamination of commercial produce or meat supplies. The goal of agro-terrorism is to cause economic crisis, social unrest, and loss of confidence in the government.

- Arson - Intentional fires have caused extensive damage during terrorist-related incidents in the past. These types of incidents may also be associated with bombings and usually target specific structures.

- Kidnappings/Assassinations - Kidnappings and assassinations may also be terrorist-related incidents, but because these events generally involve few individuals, their effect on emergency management operations may be minimal in terms of response.

C. Current Threat Assessment

The Statement for the Record on the Worldwide Threat Assessment of the U.S. Intelligence Community for the House Permanent Select Committee on Intelligence indicates terrorism will continue to remain at the forefront of our national security. The statement also indicates increased counterterrorism and information sharing efforts have assisted in halting numerous potential terrorist attacks.

- International Terrorism and Radicalization

Al-Qa'ida remains committed to high-profile attacks against the West using a range of attack methodologies. The group also recruits operatives familiar with the West. Due to the loss of

experienced personnel, the group will likely seek to augment sophisticated plots by increasing its operational tempo with smaller ones.

Some regional affiliates, particularly Al-Qa'ida in the Arabian Peninsula (AQAP) and al-Shabaab in Somalia, will likely grow stronger. The result may be regional affiliates conducting most of the terrorist attacks.

Al-Shabaab may expand its focus from fighting to control Somalia to plotting to attack the Homeland. Al-Shabaab's cadre of Westerners includes American converts, some of whom have assumed leadership positions, and other fighters of ethnic Somali-descent.

Other groups vary in their strategic agenda, external reach, and capabilities to conduct operations, including those against the Homeland. Most Al-Qa'ida in the Lands of the Islamic Maghreb (AQIM) operations against Western targets has been kidnappings-for-ransom. The group also has targeted embassies in North Africa and the Sahel, executed an American, and is augmenting its operational reach in West Africa.

Tehrik-e-Taliban Pakistan (TTP)'s involvement in attacks, such as the May 2010 failed car bombing in Times Square and the assault on the United States Consulate in Peshawar, demonstrate its intent and ability to target US interests, including the Homeland. TTP will remain heavily engaged in its efforts against the Pakistani military and Coalition Forces in Afghanistan; these actions indicate the group also is seeking to expand its international reach. Lashkar-e-Tayyiba (LT) remains a significant threat to Indian interests in South Asia and an increasing threat to US forces in Afghanistan.

Recruitment for the broader movement has been resilient. The underlying ideology continues to resonate with a small but active set of Sunni extremists across the globe who can replace operatives who are killed, arrested, or become disaffected. Ideologues and clerics in the movement aggressively exploit issues, such as the presence of US forces in Afghanistan and Iraq and US support for Israel, to fuel their narrative of a hostile West determined to undermine Islam.

The appeal of Al-Qa'ida ideology worldwide has increased the flow of Western recruits. In recent years, a small but growing number of Americans have become involved in the global jihadist movement. They have occupied a variety of roles with extremist groups overseas, such as foot soldiers and front line combatants, operational planners, propagandists, attack operatives for Homeland plots, and even senior leaders, with some American extremists combining multiple roles. American extremists will likely remain a small part of the jihad, but play a disproportionately large role in the threat to US interests because of their understanding of the Homeland, connections to the United States, and relatively easy access to the Homeland and potentially to US facilities overseas.

Disrupted plots and arrests of homegrown violent Sunni extremists were unrelated operationally, but are indicative of a collective subculture and a common cause that rallies independent extremists to want to attack the Homeland. Key to this trend has been the development of a US-specific narrative that motivates individuals to violence. This Internet-accessible narrative, a blend of al-Qa'ida inspiration, perceived victimization, and glorification of past homegrown plotting, relates to the unique concerns of US-based extremists. However, radicalization among US-based extremists remains a unique process based on each individual's personal experiences and motivating factors.

Another key concern is the ability of ideological influencers and recruiters to mobilize new recruits in the West by exploiting anti-Islamic incidents, legislation, and activities, such as threats of Koran burning and restrictions on Muslim attire. These ideologues have also proved adept at spreading their messages through the media and Internet-based platforms.

- Domestic Terrorism

Domestic terrorist attacks committed by individuals or groups are likely to remain an area of concern. This threat spectrum is vast and unique comprised of different ideological philosophies. Individuals or groups may conduct an attack to further their ideology, such as distrust in the government or a personal agenda. Additionally, the form of terrorism an individual or group utilizes is unique and may range from a non-violent cyber attack to a full-blown violent bombing of infrastructure.

D. Government Authority, Roles, and Responsibilities

- Department of Homeland Security - After the attacks on September 11, 2001, parts of 22 domestic agencies were consolidated into one department, the Department of Homeland Security (DHS), to protect the nation against future terrorist threats. Roles of those agencies include analyzing threats and intelligence, guarding national borders and airports, protecting critical infrastructure, and coordinating response efforts for future emergencies.

- Federal Bureau of Investigations - The FBI is the lead federal agency for investigating terrorism. The FBI is authorized to open an investigation whenever "facts or circumstances reasonably indicate that two or more persons are engaged in an enterprise for the purpose of furthering political or social goals wholly or in part through activities that involve force or violence and a violation of the criminal laws of the United States." In any given year, the FBI engages in approximately 24 full-scale domestic terrorism investigations. The FBI maintains a state-of-the-art computer database known as the Terrorist Information System, which contains information on known or suspected terrorist groups and individuals. The system contains information on over 200,000 individuals and over 3,000 organizations.

- Joint Terrorism Task Force - An essential weapon in the battle against terrorists is the

Joint Terrorism Task Force (JTTF). A national JTTF, located at FBI Headquarters, includes representatives from the Department of Defense, Department of Energy, Federal Emergency Management Agency, Central Intelligence Agency, Customs Service, Secret Service, and the Immigration and Naturalization Service. Additionally, there are 66 local Joint Terrorism Task Forces where representatives from federal agencies, state and local law enforcement personnel, and first responders work together to track down terrorists and prevent acts of terrorism. Two Joint Terrorism Task Forces are located in Missouri, one each in Kansas City and St. Louis.

- Federal Emergency Management Agency - After terrorist-related events, communities may receive assistance from state and federal agencies operating within the existing Integrated Emergency Management System. The Federal Emergency Management Agency (FEMA) is the lead federal agency for supporting state and local response to the consequences of terrorist attacks.

- Missouri Office of Homeland Security - Missouri was the first state to create an Office of Homeland Security in response to the Sept. 11, 2001, attacks in New York, Washington, and Pennsylvania, opening the office just two weeks after the attacks. The office is under the Department of Public Safety and provides access to the people, facilities and services of the state, such as the Highway Patrol and the National Guard.

- Missouri Information Analysis Center - In December 2005, the state opened the Missouri Information Analysis Center (MIAC). The MIAC is the state designated fusion center and employs intelligence analysts who work around the clock on issues impacting public safety, such as terrorism-related issues, criminal investigations, and hazardous chemical spills.

- National Terrorism Advisory System - The National Terrorism Advisory System (NTAS) replaced the color codes of the Homeland Security Advisory System (HSAS). NTAS is designed to effectively communicate information about terrorist threats by providing timely, detailed information to the public, government agencies, first responders, airports and other transportation hubs, and the private sector.

- Secretary of State - The US Secretary of State, in compliance with US law, provides to Congress a full and complete report on terrorism. The annual report is entitled *Country Reports on Terrorism.* The report lists state sponsors of terrorism, terrorist safe havens and terrorist organizations.

IV. MEASURE OF PROBABILITY AND SEVERITY

The threat of terrorism in the United States remains a concern. Large cities probably represent the most likely locations for terrorist acts because terrorists generally want their acts to affect the greatest number of people, cause the greatest amount of damage, reverberate in the news media, and reach the largest audience possible. However, the Oklahoma City bombing debunked the idea that rural America is completely safe from terrorists. Several different extremist groups have been identified in Missouri, but there have been no indications of any specific terrorist activities. The potential remains, however, for new extremist and/or terrorist groups to move into the state

or existing groups to implement terrorist operational plans. By sustaining these premises, it appears a terrorist attack could occur in Missouri but the probability of such an attack is low.

Should Missouri experience a terrorist attack, the severity of such an attack could range from high to low depending on the incident. Attack factors including the method utilized, the number of live lost, and the psychological impact to the community all play into the severity of the attack and vary per incident.

V. IMPACT OF THE HAZARD

Terrorist acts could cause extensive damage to infrastructure, significant loss of life, mass hysteria, and undermine the confidence people have in their own security and of the government's ability to provide protection from harm. No matter how large or small the incident, a terrorist act can have a major impact on a community.

VI. MAPS OR OTHER ATTACHMENTS

None

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ANNEX O

ATTACK
(CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR, AND EXPLOSIVE)

I. TYPE OF HAZARD

Attack (Chemical, Biological, Radiological, Nuclear, and Explosive)

II. DESCRIPTION OF HAZARD

Of all the possible disasters and hazards we can imagine, a strategic nuclear, biological, or chemical attack could be the most devastating and far-reaching in consequences. The FBI assesses, "It's a serious concern: chemical, biological, and radiological/nuclear materials—what we call weapons of mass destruction or WMD—being used to attack the U.S. The threat is real**.** The anthrax attacks of 2001 killed five Americans and terrorized the nation. And al Qaeda has openly pursued WMD and would likely use any weapons they build or buy against our nation."

Still, the potential for traditional war-related attacks, using conventional weapons, is a scenario that is more likely to occur, based on currently available information.

Although the threat of all-out nuclear war has been significantly reduced with the dissolution of the former Soviet Union, several scenarios still exist that might subject a jurisdiction to widespread radioactive contamination or high-levels of radiation exposure. When Phase II of the START II Treaty (passed by the U.S. Senate in 1996 and ratified by the Russian Duma in April, 2000), is complete, it will allow its signatories, Russia and the United States, to maintain only between 3,000 – 3,500 actual (versus accountable in the START) strategic nuclear weapons each, a significant reduction from Cold War numbers. The Obama Administration has been in discussion with Russia and other nations to sharply reduce the stockpile by as much as another 80%.

In February 2009 the Director of National Intelligence stated, … we judge Beijing seeks to modernize China's strategic forces in order to address concerns about the survivability of those systems in the face of foreign, particularly US, advances in strategic reconnaissance, precision strike, and missile defenses. We assess China's nuclear capabilities will increase over the next ten years. Five other nations have declared their nuclear capability and another 5 are suspected of having developed nuclear weapon technology, including trouble spots, North Korea and Iran. Additionally, 15 nation states have either had weapons, or programs to develop nuclear weapons, but have reportedly abandoned their efforts. Most have now signed the nuclear non-proliferation treaty. The Department of Defense estimates that as many as 26 nations may possess chemical agents or weapons, and an additional 12 may be seeking to develop them. The Central Intelligence Agency reports that at least 10 countries are believed to be conducting research on biological agents for weaponization.

Concerns over the use of chemical and biological warfare agents have increased. Recent events, such as the September 11, 2001, terrorist attacks on the World Trade Center buildings in New York City and the Pentagon in Washington D.C., along with the anthrax-related attacks in 2001, have increased awareness of the vulnerability of the U.S. to future attacks involving chemical or biological warfare agents. For more information on terrorist-related issues, see the Terrorism annex (Annex N) of this document.

In this year's (2012) address to the Senate Armed Services Committee, Ronald L. Burgess, Jr., Lieutenant General, USA, Director, Defense Intelligence Agency said, "The proliferation and potential for use of weapons of mass destruction (WMD) and ballistic missiles remains a grave and enduring threat. Securing nuclear weapons and materials is a worldwide imperative to prevent both accidents and the potential diversion of fissile and radiological materials. Chemical and biological weapons are becoming more technically sophisticated as technology proliferates. Terrorist organizations are working to acquire and employ chemical, biological, and radiological materials."

In a February 2009 report to the Senate Select Committee on Intelligence Dennis C. Blair, Director of National Intelligence reported, The ongoing efforts of nation-states to develop and/or acquire dangerous weapons and delivery systems in the Middle East and elsewhere constitute another major threat to the safety of our nation, our deployed troops, and our allies. We are most concerned about the threat and destabilizing effect of nuclear proliferation. The threat from the proliferation of materials and technologies that could contribute to both existing and prospective biological and chemical weapons programs also is real. Most of the international community shares these concerns.

WMD use by most nation states traditionally has been constrained by the logic of deterrence and by diplomacy, but these constraints may be of less utility in preventing the use of mass-effect weapons by terrorist groups. Moreover, the time when only a few states had access to the most dangerous technologies is long over. Technologies, often dual-use, circulate easily in our globalized economy, as do the personnel with scientific expertise who design and use them. Therefore, it is difficult for the United States and its partners to track efforts to acquire components and production technologies that are widely available.

We assess countries that are still pursuing WMD programs will continue to try to improve their capabilities and level of self-sufficiency over the next decade. Over the coming years, we will continue to face a substantial threat, including in the US Homeland, from terrorists attempting to acquire biological, chemical, and possibly nuclear weapons and use them to conduct large-scale attacks. Conventional weapons and explosives will continue to be the most often used instruments of destruction in terrorist attacks; however, terrorists who are determined to develop CBRN capabilities will have increasing opportunities to do so, owing to the spread of relevant technological knowledge and the ability to work with CBRN materials and designs in safe havens.

III. HISTORICAL STATISTICS

In 960-1279 A.D. arsenical smoke (a form of chemical warfare) was used in battle during China's Sung Dynasty and in 1346-1347, Mongols catapulted corpses (biological warfare) contaminated with plague over the walls into Kaffa (in Crimea), forcing besieged Genoans to flee. During World War I (1915-1918), chemical and conventional weapons were used. The first poison gas, chlorine, was used by the Germans against Allied troops in 1915. The effects of the gas were devastating, causing severe choking attacks within seconds of exposure. The British subsequently retaliated with chlorine attacks of their own, although reportedly more British suffered than the German troops, because the gas blew back into their own trenches. Phosgene was later used in the war because it caused less severe coughing, resulting in more of the agent being inhaled. Then, in September 1917, mustard gas was used in artillery shells by the Germans against the Russians. Mustard gas caused serious blisters, both internally and externally, several hours after exposure. In all, there were 1,240,853 gas-related casualties and 91,198 deaths from gas exposure during World War I.

During World War II (1941-1945), atomic (nuclear), chemical, and conventional weapons were used. Use of chemical weapons in World War II was not as prevalent as in World War I, and was primarily limited to the Japanese Imperial Army. During the war, the Japanese used various chemical-filled

munitions, including artillery shells, aerial bombs, grenades, and mortars, against Chinese military forces and civilians. Chemical agents used included phosgene, mustard, lewisite, hydrogen cyanide, and diphenyl cyanarsine. The war was brought to an abrupt end in 1945, when the U.S. dropped two atomic bombs on Japan: one on Hiroshima that obliterated the entire city and killed approximately 66,000 people, and another on Nagasaki that destroyed about half the city and killed about 39,000 people.

During the Vietnam War (1964-1973), chemical and conventional weapons were used. Chemical weapons used during the Vietnam War are believed to have only involved tear agents used by the U.S., and possibly psychedelic agents, also by the U.S. Although not directly used as warfare agents, toxic herbicides such as Agent Orange were commonly used as defoliants by the U.S. Long-term exposure to Agent Orange, which contained the contaminant dioxin, was believed to cause illness and disease in humans.

In 1983, Iraq launched its first of 10 documented chemical attacks against Iran. The largest of these attacks was in February 1986, when mustard gas and the nerve agent tabun were used, impacting up to 10,000 Iranians. Although the exact number of chemical attacks implemented by Iraq during the war is unknown, the Iranian government estimates that more than 60,000 soldiers had been exposed to mustard gas and the nerve agents sarin and tabun by the time the war ended in 1988. Based on these data, the Iraqi chemical attacks during the Iran-Iraq war were the largest since World War I.

Although several isolated attacks involving biological agents have occurred over the last few decades, the most recent series of incidents in the U.S. that gained nationwide exposure occurred between early October and early December 2001, when five people died from anthrax infection, and at least 13 others contracted the disease in Washington, D.C.; New York City; Trenton, New Jersey; and Boca Raton, Florida. Anthrax spores were found in a number of government buildings and postal facilities in these and other areas. Most of the confirmed anthrax cases were tied to contaminated letters mailed to media personalities and U.S. Senators. Thousands of people were potentially exposed to the spores and took preventive antibiotics. Numerous mail facilities and government buildings were shut down for investigation and decontamination. In the wake of these incidents, federal, state, and local emergency response agencies across the United States responded to thousands of calls to investigate suspicious packages, unknown powders, and other suspected exposures. Fortunately, almost all of these incidents turned out to involve no actual biohazard.

IV. MEASURE OF PROBABILITY AND SEVERITY

Attacks against the United States as a whole, and against individual states or local entities, can be categorized as originating from either domestic or international sources. However, because the impacts on life and property would largely be the same regardless of the source of such an attack, similar preparedness, response, and recovery activities apply.

Biological and chemical weapons have often been used to terrorize an unprotected population, instead of actual use as weapons of war. However, the potential damage that can occur in the event of such an attack is huge, particularly to human health.

A single nuclear weapon detonation could cause massive destruction, and all aforementioned types of attacks could cause extensive casualties. An all-out nuclear attack could affect the entire population in the vicinity of the impacted area. Some areas would experience direct weapons effects: blast, heat, and initial nuclear radiation. Other areas would experience indirect weapons effects, primarily radioactive fallout. As long as world leaders maintain rational thinking, the probability of an attack by a nation-state remains low, but does not rule out attack by a terrorist group.

Secondary effects of these attacks, which could severely stress the country, include lack of adequate shelter, food, water, health and medical facilities and personnel, and mortuary services, disruption of communication systems, and power outages. Because of the potential devastation and significant secondary effects caused by this type of attack, the severity is rated high.

V. IMPACT OF THE HAZARD

The population is vulnerable to two separate categories of impacts associated with these types of attacks: direct and indirect impacts. For more information on these impacts, which are often connected to terrorist-related activities, see the Terrorism annex (Annex N) of this document.

A. Direct Effects

These are effects directly associated with detonation or use of the weapon.

1. Conventional Weapons

Direct effects of conventional weapons generally are related to injuries inflicted by penetration of ammunition rounds or shrapnel from exploding ordnance (mortars, etc.). Injuries from shock waves/blast overpressure near the targets may also occur, along with damage caused by fires produced from incendiary warheads, grenades, and other munitions. In addition, some injuries may occur as a result of flying or falling debris where the weapons are used. Heavy artillery can also damage roadways and buildings, and disrupt utility services for lengthy periods of time.

2. Chemical and Biological Weapons

Direct effects of chemical weapons involve initial spread of agents and fragmentation of the weapons. Chemical agents are toxins used to produce neurological and pulmonary injuries or death. Biological agents are infectious microbes used to produce illness or death. They can be dispersed as aerosols or airborne particles directly onto a population, producing an immediate effect (a few seconds to a few minutes for chemical agents) or a delayed effect (several hours to several days for biological agents). Severity of injuries depends on the type and amount of the agent used and duration of exposure. Because some biological agents take time to grow and cause disease, an attack using this type of agent may go unnoticed for several days.

3. Nuclear Weapons

Direct effects include intense heat, blast energy, and high-intensity nuclear radiation. These effects are extremely dependent on weapon size, altitude of burst, and atmospheric conditions.

4. Agriterrorism

The direct effect of agriterrorism is the intentional introduction of a contagious animal disease or fast spreading plant disease that affects livestock and food crops and disrupts the food supply chain. Agriterrorism could cause disease in livestock, crops, and in some

cases (anthrax, or monkey pox, for example), humans. Diseases that can be transmitted to humans from animals are called zoonotic. It would not only require the agriculture industry to destroy livestock and food crops, but also affect the consumer confidence in the food supply resulting in tremendous economic damage for, potentially, an extended period. The food supply could be severely affected not only for the immediate area and the U.S., but the world market since the U.S. exports huge quantities of food to other nations. Recently the federal government has recognized the vulnerability of the agricultural/food supply industry and potential debilitation from a terrorist incident and acted to protect the resources through Presidential Decision Directives and encouraged complementary state and local actions.

5. Radiological Weapon

Direct effects of a radiological weapon are the same as a conventional high explosive, but with the added danger posed by exposure to radiological materials. A Radiological Dispersion Device (RDD) or “dirty bomb” will contaminate an area by spreading radiological dust and debris over a large area.

6. Explosive Weapon (large amount of high explosive)

The direct results of an explosive weapon are immense destruction caused by the blast and could result in multiple fatalities. Instances of these effects include Oklahoma City, Kobhar Towers, the marine barracks in Lebanon, and the African Embassy bombings.

B. Indirect Effects

These are effects not directly associated with the detonation and use of the weapon.

1. Conventional Weapons

Unexploded ordnance throughout a battle zone or explosion hazards to those in the area can persist after warfare has ended. Many conventional munitions also contain toxic compounds that can leach into surrounding soils and groundwater if left in place.

2. Chemical and Biological Weapons

Indirect effects are generally limited to downwind areas. They can be geographically widespread and vary in intensity—depending on weapon size, type of chemical or biological agent, and wind patterns. The spread of these agents can contaminate food and water supplies, destroy livestock, and ravage crops.

3. Nuclear Weapons

When a nuclear weapon detonates, intense heat, blast and overpressure will cause severe injuries and fatalities in the surrounding area and radiation poisoning at more distant locations. A nuclear detonation near or on the ground draws up large quantities of earth and debris into a mushroom cloud. This material becomes radioactive, and the particles can be carried by wind hundreds of miles before they drop back to earth as "fallout." In

an attack, many areas of the United States would probably escape fallout altogether or experience non-life-threatening levels of radiation. However, because weather that determines where fallout will land is so unpredictable, *no* locality in the United States is free from risk of receiving deadly radiation levels after a strategic attack. Less than lethal exposures will result in longer-term effects on health and contamination of food, water, and food production.

4. Agriterrorism

Agriterrorism's indirect effects are loss of breeding stock to replenish herds and flocks; loss of seed crops; and possibly loss of land use for a long period of time depending on the disease involved. Agriterrorism has a high probability of creating an economic disaster for states highly vested in food production, and potentially the nation.

5. Radiological Weapon

The indirect effect of a RDD is inability to use the contaminated area for a short-to long-time period, depending on the identity of the radioactive material. Because radioactive material from a RDD can penetrate wood, asphalt, concrete, and masonry (and radioactive dust and particles can enter the smallest crevices), decontamination will be extremely difficult or impossible.

6. Explosive Weapon (large amount of high explosive)

The indirect effect of an explosive weapon is the fear, terror, and lasting psychological damage to survivors and other individuals.

VI. SYNOPSIS

Even though the START treaty has reduced the overall number of nuclear weapons, and many chemical/biological weapons stockpiles have been and are being destroyed, we must continue to plan for, and be prepared for, this type of hazard. In many ways, while the risk of a nuclear exchange by the "super-powers" is greatly reduced, the potential risk of proliferation of WMD is greater than during the Cold War era.

While it may not be possible to prevent such an attack, steps can be taken to lessen the likelihood or the potential effects of an incident by implementing certain measures:

- Identifying and organizing resources
- Conducting a risk or threat assessment and estimating losses
- Identifying mitigation measures that will reduce the effects of the hazards and developing strategies to deal with the mitigation measures in order of priority
- Implementing the measures and evaluating the results through recurring exercises and keeping the plan up-to-date.

VII. MAPS OR OTHER ATTACHMENTS

No attachments or maps are available.

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ANNEX P

PUBLIC HEALTH EMERGENCIES; ENVIRONMENTAL ISSUES

I. TYPE OF HAZARD

Public Health Emergencies; Environmental Issues

II. DESCRIPTION OF HAZARD

Public health emergencies can take many forms—disease epidemics, large-scale incidents of food or water contamination, or extended periods without adequate water and sewer services. There can also be harmful exposure to chemical, radiological, or biological agents, and large-scale infestations of disease-carrying insects or rodents. The first part of this section focuses on emerging public health concerns and potential pandemics, while the second part addresses air and water pollution caused by natural or man-induced means.

Public health emergencies can occur as primary events by themselves, or they may be secondary to another disaster or emergency, such as tornado, flood, or hazardous material incident. For more information on those particular incidents, see Annex A (Tornadoes/Severe Thunderstorms), Annex B (Riverine Flooding), and Annex K (Hazardous Materials). The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be worldwide or localized in scope and magnitude.

In particular, two public health hazards have recently emerged as issues of great concern, with far reaching consequences. One pertains to the intentional release of a radiological, chemical, or biological agent, as a terrorist act of sabotage to adversely impact a large number of people. For more information on biochemical terrorism (including discussions on potential pandemics and other public health emergencies), see the Annex N of this document. The second hazard concerns a deadly outbreak (other than one caused by an act of terrorism) that could kill or sicken thousands of people across the county or around the globe, as in the case of the Spanish Flu epidemic of 1918-1919.

Pandemic Influenza: How Does an Influenza Pandemic Start?
There are three main types of influenza viruses: A, B, and C. While influenza C causes only mild disease and has not been associated with widespread outbreaks, influenza types A and B cause epidemics nearly every year. Influenza A viruses are divided into subtypes, based on differences in two surface proteins: hemagglutinin (H) and neuraminidase (N). Influenza B viruses are not divided into subtypes. During an influenza season, usually one or more influenza A subtype and B viruses circulate at the same time.

A pandemic is possible when an influenza A virus makes a dramatic change (i.e., "shift") and acquires a new H or H+N. This shift results in a new or "novel" virus to which the general population has no immunity. The appearance of a novel virus is the first step toward a pandemic. In order to cause a pandemic, the novel influenza A virus must also spread easily from person-to-person causing serious disease. Influenza B viruses do not undergo shift and do not cause influenza pandemics.

The reservoir for type A influenza viruses is wild birds; but influenza A viruses also infect animals such as pigs and horses, as well as people. The last two pandemic viruses were combinations of bird and human influenza viruses. Many believe that these new viruses emerged when an intermediate host, such as a pig, was infected by both human and bird influenza A viruses at the same time, creating a new virus. Events in Hong Kong in 1997, however, showed that this is not the only way that humans can become infected with a novel virus. Sometimes,

an avian influenza virus can "jump the species barrier" and move directly from avian species to humans to cause disease.

Since, by definition, a novel virus is a virus that has never previously infected humans, or has not infected humans for a long time, it is likely that almost no one will have immunity or antibodies to protect them against the novel virus. Therefore, anyone exposed to the virus--young or old, healthy or weak--could become infected and get sick. If however, the novel virus is related to a virus that circulated long ago, older people who might have been exposed to it in their childhood could have some level of immunity. It has been suggested that because of immunity issues, a novel virus might strike hardest at healthy young adults – an age group not usually considered at risk of severe illness or death from annual influenza. Such widespread vulnerability in the population could lead to a potentially devastating pandemic.

Environmental concerns addressed in this annex focus on air and water pollution, because contamination of those media can have widespread impacts on public health, with devastating consequences. Particular issues of primary concern associated with sources of air and water pollution change over time depending on recent industrial activity, economic development, enforcement of environmental regulations, new scientific information on adverse health effects of particular contaminants or concentrations, and other factors. Those issues are detailed in Sections VI and VII of this annex.

III. HISTORICAL STATISTICS

A. Influenza Pandemics

Epidemic influenza, an age-old infectious disease, results in over 30,000 deaths in the United States every year and is a significant disease. Since the early 1900s, four influenza pandemics have swept the globe, although none have compared to the infamous Spanish Flu event of 1918-1919, which killed more than 20 million people. The 1957 Asian Flu, the 1968 Hong Kong Flu, and the 2009 H1N1 pandemics all saw increased illnesses and deaths compared to seasonal outbreaks, although they weren't nearly as virulent as the 1918 strain. The 1957 epidemic killed about 70,000 people in the United States, mostly the elderly and chronically ill. Another 34,000 Americans died from the 1968 epidemic. While both of these latter epidemics cost many lives, neither was as severe as the Spanish Flu of 1918, which claimed from 500,000 to 700,000 lives in the U.S alone. The impact from this pandemic was felt especially hard in society as its primary victims were mostly young, healthy adults. In addition to those three pandemics, several "pandemic scares" have occurred.

1. Spanish Flu of 1918-1919

In 1918, while World War I was in its fourth year, another threat began that would rival the war itself, smallpox, and the black plague of the Middle Ages as the greatest killer in human history. The Spanish Flu swept the world in three waves during a 2-year period, beginning in March 1918 with a relatively mild assault. The first reported case occurred at Camp Funston (Fort Riley), Kansas, where 60,000 soldiers trained to be deployed overseas. Within 4 months, the virus traversed the globe, as American soldiers brought the virus to Europe. The first wave sickened thousands of people and caused many deaths (46 died at Camp Funston), but it was considered mild compared to what was to come. The second and deadliest wave struck in the autumn of 1918 and killed millions. At Camp Funston alone, there were 14,000 cases reported and 861 deaths during the first 3 weeks of October 1918. Outbreaks caused by a new variant exploded almost simultaneously in many locations, including France, Sierra Leone, Boston, and New York City, where more than 20,000 people died that fall. The flu gained its name from Spain, which was one of the hardest hit countries and covered the outbreak widely in the media. From there, the flu went through the Middle East and around the world, eventually returning to

the U.S. as the troops came home during its second wave. Of the 57,000 Americans who died in World War I, 43,000 died as a result of the Spanish influenza. At one point, more than 10 percent of the American workforce was bedridden. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza in 1918-1919, leaving 20 million people dead.

In 1918, Missouri's influenza death rate was 293.83 per 100,000 people, for a total of 9,677 deaths statewide from that cause alone. That figure represents18.6 percent of Missouri's total deaths that year. While the cause of the Spanish Flu remains somewhat a mystery, the epidemic was generally traced to pigs on Midwest farms, which then spread the deadly virus to farm families. As fall crops were ready for harvest in 1918, there were no field hands to get the crops in, thereby creating an agricultural disaster as well. A third wave of the Spanish Flu, much less devastating than its predecessors, made its way through the world in early 1919 and then finally died out.

Missouri's flu death rate in 1919 dropped to less than half that of the previous year (107.21 per 100,000), and by 1921, it was reduced to 87.24 deaths per 100,000 people, state statistics show.

2. Asian Flu of 1957

In February 1957, this flu pandemic was first identified in the Far East. Unlike the Spanish Flu pandemic, the 1957 virus was quickly identified, and vaccine production began in May 1957. A number of small outbreaks occurred in the U.S. during the summer of 1957, with infection rates highest among school children, young adults, and pregnant women; however, the elderly had the highest rates of death. A second wave of infections occurred in early 1958, which is typical of many pandemics.

3. Hong Kong Flu of 1968

In early 1968, this influenza pandemic was first detected in Hong Kong. The first cases in the U.S. were detected in September 1968, although widespread illness did not occur until December. This became the mildest pandemic of the 20th century, with those over the age of 65 being the most likely to die. People with earlier infections by the Asian Flu virus may have developed some immunity against the Hong Kong Flu virus. Also, this pandemic peaked during school holidays in December, limiting student-related infections.

4. Flu Scares: Swine Flu of 1976

In 1976, a swine-type influenza virus appeared in a U.S. military barracks (Fort Dix, New Jersey). Scientists determined it was an antigenically drifted variant of the feared 1918 virus. Fortunately, a pandemic never materialized, although the news media made a significant argument about the need for a Swine Flu vaccine.

5. The Avian Flu –Asian Stain H5N1

The Asian Strain H5N1 Avian Flu virus has been especially virulent, and made an unusual jump from poultry to humans. At least 18 people were infected, and six died in the outbreak. Since 2003, a growing number of human H5N1 cases have been reported in Asia, Europe, and Africa. More than half of the people infected with the H5N1 virus have died. Most of these cases are all believed to have been caused by direct exposure to infected poultry. There has been no sustained human-to-human transmission of the disease, but the concern is that H5N1 could evolve into a virus capable of human-to-human transmission. See Table below for history of activity.

Cumulative Number of Confirmed Human Cases of Avian Influenza A/ (H5N1) Reported to WHO, 2003-2013

Country	2003-2009		2010		2011		2012		2013		Total	
	CASES	DEATHS	CASES	DEATHS	CASES	DEATHS	CASES	DEATHS	CASES	DEATHS	CASES	DEATHS
Azerbaijan	8	5	0	0	0	0	8	0	0	0	**8**	**5**
Bangladesh	1	0	0	0	2	0	3	0	1	1	**7**	**1**
Cambodia	9	7	1	1	8	8	3	3	26	14	**47**	**33**
China	38	25	2	1	1	1	2	1	2	2	**45**	**30**
Djibouti	1	0	0	0	0	0	0	0	0	0	**1**	**0**
Egypt	90	27	29	13	39	15	11	5	4	3	**173**	**63**
Indonesia	162	134	9	7	12	10	9	9	3	3	**195**	**163**
Iraq	3	2	0	0	0	0	0	0	0	0	**3**	**2**
Lao People's Democratic Republic	2	2	0	0	0	0	0	0	0	0	**2**	**2**
Myanmar	1	0	0	0	0	0	0	0	0	0	**1**	**0**
Nigeria	1	1	0	0	0	0	0	0	0	0	**1**	**1**
Pakistan	3	1	0	0	0	0	0	0	0	0	**3**	**1**
Thailand	25	17	0	0	0	0	0	0	0	0	**25**	**17**
Turkey	12	4	0	0	0	0	0	0	0	0	**12**	**4**
Viet Nam	112	57	7	2	0	0	4	2	2	1	**125**	**62**
Total	**468**	**282**	**48**	**24**	**62**	**34**	**32**	**20**	**38**	**24**	**648**	**384**

Total number of cases includes number of deaths.
Who reports only laboratory confirmed cases.
All dates refer to onset of illness.

B. Other Diseases of Public Health Concern

1. Smallpox

Smallpox is a contagious, sometimes fatal, infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination. Smallpox is caused by the variola virus that emerged in human populations thousands of years ago. It is generally spread by face-to-face contact or by direct contact with infected bodily fluids or contaminated objects (such as bedding or clothing). A person with smallpox is sometimes contagious with onset of fever, but the person becomes most contagious with the onset of rash. The rash typically develops into sores that spread over all parts of the body. The infected person remains contagious until the last smallpox scab is gone. Smallpox outbreaks have occurred periodically for thousands of years, but the disease was declared eradicated in 1980 after a worldwide vaccination program was implemented. After the disease was eliminated, routine vaccination among the general public was stopped. The last case of smallpox in the United States was in 1949.

It should be noted that after recent terrorist events in the U.S., there is heightened concern that the variola virus might be used as an agent of bioterrorism. For this reason, the U.S. government is taking precautions for dealing with a small pox outbreak. For further information on this issue, see the Terrorism section of this report (Section N).

2. Meningitis

Meningitis is an infection of a person's spinal cord and the fluid surrounding the brain. High fever, headache, and stiff neck are common symptoms of meningitis in persons over the age of two. These symptoms may not be present or difficult to detect in newborns and infants who may only appear slow or inactive, or be irritable, vomiting, or feed poorly. Viral meningitis is the most common cause of meningitis and though potentially severe, is rarely fatal. There are a variety of bacteria that can also cause meningitis. Meningococcal meningitis caused by the bacteria *Neisseria meningitides*, is one of the leading causes of bacterial meningitis in the U.S., with 1,400 – 2,800 cases estimated to occur annually. The bacteria are spread through the exchange of respiratory and throat secretions (i.e., coughing, kissing) from an infected person. Risk groups include infants and young children, household contacts of a case, college freshmen who live in dormitories and persons exposed to active and passive tobacco smoke. Generally, 10% - 14% of meningococcal disease cases are fatal, and 11% - 19% of those who recover will have permanent hearing loss, mental retardation, loss of limbs, or other serious effects. Vaccines are available that protect against several of the common causes of bacterial meningitis including many groups of *Neisseria meningitides, Haemophilus influenza* type b (Hib), and *Streptococcus pneumonia* (pneumococcal disease).

3. Tickborne Illnesses

Rocky Mountain Spotted Fever (RMSF) and ehrlichiosis are bacterial infections that typically result from the bite of an infected tick. RMSF, caused by the bacteria *Rickettsia rickettsii,* is the most frequently reported tickborne illness in Missouri. Over 125 cases of RMSF have been reported

annually in Missouri during the years 2005-2007. Ehrlichiosis refers to a group of diseases caused by bacteria called *Ehrlichia*, and is currently second to only RMSF as the most commonly reported tickborne illness in Missouri. The initial symptoms of RMSF and ehrlichiosis are similar and generally include a sudden onset of fever, headache, and muscle aches. Other signs and symptoms may include nausea, vomiting, diarrhea, cough, joint pains, confusion, and a rash. The appearance of a rash is common in persons with RMSF and children with ehrlichiosis however, is relatively uncommon in adults with ehrlichiosis. The early symptoms of both illnesses resemble other infectious and non-infectious diseases and therefore, can be difficult to diagnose. Without prompt treatment with the proper antibiotics, RMSF and ehrlichiosis illnesses can be severe and potentially fatal.

4. West Nile Virus

West Nile Virus (WNV) is a virus spread by infected mosquitoes and is commonly found in Africa, West Asia, and the Middle East. It is closely related to Se. Louis encephalitis virus, which is also found in the United States. The virus can infect humans, birds, mosquitoes, horses and some other mammals. Most people who become infect with WNV will have either no symptoms or only a mild illness with symptoms such as fever, headache, body aches, nausea and vomiting. These symptoms may last for a few days to several weeks. However, about one in 150 people infected with WNV will develop a severe illness, which may include neck stiffness, mental confusion, coma, convulsions, vision loss, numbness and paralysis. These symptoms may last several weeks, and neurological effects could be permanent. Persons over the age of 50 are more likely to develop a severe illness associated with WNV infection and should take special care to avoid mosquito bites. Experts believe WNV is established as a seasonal epidemic in North America flaring up in the summer and continuing into the fall. As of December 16, 2013, there have been 16 confirmed cases in Missouri.

5. Severe Acute Respiratory Syndrome (SARS)

Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. The virus that causes SARS is thought to spread most readily by respiratory droplets (droplet spread) produced when an infected person coughs or sneezes. The virus can also spread when a person touches a surface or object contaminated with infectious droplets and then touches his or her mouth, nose, or eye(s). In general, SARS begins with a high fever (temperature greater than 100.4°F [>38.0°C]). Other symptoms may include headache, an overall feeling of discomfort, and body aches. Some people also have mild respiratory symptoms at the outset. About 10 percent to 20 percent of patients have diarrhea. After 2 to 7 days, SARS patients may develop a dry cough and have trouble breathing.

C. Environmental Incidents

For information regarding historical incidents involving air and water pollution in Missouri, see Annex K of this document.

IV. MEASURE OF PROBABILITY AND SEVERITY

Health officials agree there is a high probability we will see another pandemic influenza virus emerge sometime in the future. In fact, a worldwide influenza outbreak on the scale and severity of the Spanish Flu is potentially possible. Should such a virulent virus strike today, the results in Missouri and elsewhere could be catastrophic without adequate planning and resources. Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the speed of air travel means the virus literally could be spread around the globe within hours. Under such unique conditions, there may be very little warning time. Most experts believe we will have just a few days, possibly a few weeks, between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the U.S. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make an influenza pandemic unlike any other public health emergency or community disaster.

Environmental concerns are also on the rise, with recent scientific data emphasizing the long-term impacts that air and water pollution can have on the ecology of the affected areas. With continued enforcement of regulatory standards for airborne releases and discharges to waterways, routine emissions by industrial facilities are relatively easy to monitor and control. However, the potential always remains for unauthorized dumping and releases, and for failure of systems to control industrial discharges, resulting in potential environmental emergencies.

V. IMPACT OF THE HAZARD

For planning purposes, it is reasonable to assume a rapid movement of a pandemic flu virus from major metropolitan areas to rural areas of the state. The effect of a pandemic on individual communities would likely be relatively prolonged—weeks to months. The impact of the next pandemic could have a devastating effect on the health and well being of Missouri citizens and the American public. For such an outbreak in the future, if planning and preparations were inadequate, CDC estimates that in the U.S. alone:

- Up to 200 million persons will be infected.
- Between 40 and 100 million persons will become clinically ill.
- Between 18 and 45 million persons will require outpatient care.
- Between 300,000 and 800,000 persons will be hospitalized.
- Between 88,000 and 300,000 people will die nationwide.
- Effective preventive and therapeutic measures, including vaccines and antiviral agents, likely will be in short supply, as well as some antibiotics to treat secondary infections.
- Based on the CDC's preliminary estimates, economic losses from the next pandemic may range from $71 to $166 billion, depending on the attack rate.

Compared to public health emergencies, as previously described, environmental incidents involving air and water pollution would likely impact a more localized area; however, long-term effects on the

environment in the impacted area could linger for many years.

VI. SYNOPSIS

A. Public Health Emergencies

The Missouri Department of Health and Senior Services (MDHSS) and the State Emergency Management Agency (SEMA) were selected by the CDC and the Council of State and Territorial Epidemiologists (CSTE) to test a national plan for dealing with a catastrophic flu outbreak. MDHSS and SEMA designed an interactive exercise, "FLUEX '98," to test two draft national response documents: (1) Influenza Pandemic Preparedness Action Plan for the United States, and (2) Pandemic Influenza: A Planning Guide for State and Local Officials. These documents were used for the design of FLUEX, and during the exercise itself. FLUEX was held February 4-5, 1998, in the State Emergency Operations Center at SEMA headquarters in Jefferson City, Missouri, and included more than 100 participants. Missouri was the only state in the nation to hold such an exercise, and one of only six states to help test the proposed national plan. Major topics explored during FLUEX included the following:

- Identifying quickly circulating viruses
- Allocating potentially scarce vaccine supplies
- Communicating emergency health information to the public
- Keeping essential public safety services operating during a time of widespread illness among employees.

As a follow-up to that planning event, the Federal Emergency Management Agency (FEMA) conducted a satellite video conference on planning for an influenza pandemic, which was broadcast nationally on February 25, 1999. SEMA, MDHSS, and local health departments hosted sites for the telecast across the state. The videoconference highlighted Missouri's planning efforts to date and featured health officials from Connecticut and Maine. They joined with a special panel at CDC headquarters in Atlanta, including SEMA's exercise officer, to answer a wide range of call-in questions on crisis management for a pandemic.

The sudden and unpredictable emergence of pandemic influenza and its potential for causing severe health, social, and economic consequences strongly requires the need for a comprehensive, action-oriented strategy. Principal goals of the national plan are two-fold: to improve prevention and control of influenza in the U.S. during the present (interpandemic) period, and to identify and implement specific ways and procedures to improve readiness for a future pandemic. As the CDC revises the draft national plan, Missouri has prepared an emergency response plan to deal with an influenza pandemic on the state level. MDHSS emphasizes that Missouri needs to prepare now to deal with challenges that could arise, such as vaccine shortages, widespread illness, and disruption in essential services. This was proven to be a pre-cursor for the bioterrorism planning and exercising that was a result of the anthrax event that occurred in October 2001. Following this event the MDHSS and the LPHAs in Missouri played a significant role in all emergency/disaster preparedness. The planning culminated in the Missouri Pandemic Planning Summit held on February 23, 2006. For all up to date information, go to: http://health.mo.gov/living/healthcondiseases/communicable/influenza/index.php

B. Environmental Issues

Although Missouri has never had an environmental disaster of large proportions, there are many instances where hazardous substances can impact the environment with considerable consequences to either air or water. Floods often temporarily interrupt community water supplies, creating the need for emergency potable water for thousands of people. In July 1993, for example, St. Joseph's municipal water plant was forced to shut down for an extended period when contaminated floodwater threatened to enter the system. Floodwaters also disrupt wastewater treatment facilities, resulting in the discharge of raw or improperly treated sewage. Periodically, water pollutants cause fish kills in Missouri streams, and excessive air pollutants associated with smog in large metropolitan areas create public health problems.

1. Air Pollution

Staff in the air quality monitoring section operate approximately a variety of instruments at 41 locations around the State as part of a network to monitor air pollutants known to affect people's health. For more information go to http://www.dnr.mo.gov/env/apcp/index.html

Because of high amounts of ozone, carbon dioxide, nitrogen compounds, and other vehicular pollutants in the St. Louis metropolitan area, vehicles registered in the counties of St. Louis, St. Charles, and Jefferson, as well as St. Louis City, are required to have their exhaust systems routinely checked to determine whether emissions standards are being achieved. In addition, all service stations around St. Louis are now required to have new gas nozzles that recapture gasoline vapors, thus preventing them from being released to the atmosphere. These vapors (unburned hydrocarbons) chemically react with nitrogen oxides when exposed to the sunlight and form ozone, which is the basis for smog. For more information on Missouri's Air Pollution Control Program, contact the Missouri Department of Natural Resources at www.dnr.mo.gov/ or call 573-751-1300 or 1-800-361-4827.

2. Water Pollution

The Missouri Department of Natural Resources also maintains the state's water quality management plan, and has developed individual plans for each drainage basin in Missouri. Those drainage basins may be divided into the following geographic categories: Upper Mississippi River tributaries, Lower Mississippi River tributaries, Missouri River tributaries north of the Missouri River, Missouri River tributaries south of the Missouri River, White River tributaries, and Arkansas River tributaries. For the most up to date information on water pollution go to http://www.dnr.mo.gov/env/wpp/index.html or call 573-751-1300 or1-800-361-4827.

3. Hazardous Waste Program

The Missouri Department of Natural Resources has a highly regarded Hazardous Waste Program. The goal of the Hazardous Waste Program is to protect human health and the environment from threats posed by hazardous waste. The program does the following to accomplish this goal:

- Encourages the reduction of hazardous waste generation.
- Regulates the management of hazardous waste.

- Oversees the cleanup of contamination.
- Promotes property reuse and regulates the management.
- Removal and cleanup of petroleum storage tanks in the State.

Go to http://www.dnr.mo.gov/env/hwp/index.html for more information.

C. Identifying Pollution Hazard Areas due to Natural Disasters

Local emergency management officials should identify pollution hazard areas so that in case of a natural disaster, recovery steps will not be delayed. Pollution of public drinking water, for example, can cause severe problems with re-entry and recovery. If alternate sources of safe drinking water can be identified, or relocation of water intakes can eliminate polluted drinking water, then recovery can be quicker, and local resources can be used to address other problems. Go to http://www.dnr.mo.gov/disaster.htm for more information on natural disasters and how they can affect the environment as well as how the Department of Natural Resources responds to a disaster or call the Missouri Department of Natural Resources at 800-361-4827.

VII. MAPS AND OTHER ATTACHMENTS

Environmental Issues: Go to http://www.dnr.mo.gov/directory.htm for all of the maps, charts, and other attachments.

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ANNEX Q

SPECIAL EVENTS CONSIDERATIONS

I. TYPE OF HAZARD

A. National Special Security Events (NSSE)

A number of factors are taken into consideration when designating an event as a National Special Security Event including a few outlined below:

1. Anticipated attendance by dignitaries - Events that are attended by officials of the United States Government and/or foreign dignitaries may create an independent federal interest in ensuring that the event transpires without incident and that sufficient resources are brought to bear in the event of an incident.
2. Size of the event - A large number of attendees and participants generally increases the security requirements. In addition, larger events are more likely to draw the attention of terrorists or other criminals, particularly those interested in employing weapons of mass destruction.
3. Significance of the event - Some events have historical, political and/or symbolic significance that may heighten concern about possible terrorist acts or other criminal activity.

When an event is designated a National Special Security Event, the Secret Service assumes its mandated role as the lead federal agency for the design and implementation of the operational security plan and coordinator for all Federal resources deployed to maintain the level of security needed for the designated events. The Federal Bureau of Investigation (FBI) serves as the lead agency responsible for intelligence and law enforcement operations as well as statutory Federal criminal investigations. The goal of such an operation is to prevent terrorist attacks and criminal acts.

Once an event is designated a National Special Security Event, the Secret Service employs existing partnerships with federal, state and local law enforcement and public safety officials with the goal of coordinating federal, state and local agencies to provide a safe and secure environment for the event and those in attendance.

Resources used as part of past NSSE operational security plans that could be deployed for upcoming NSSE designated events include physical infrastructure security fencing and barricades, special access accreditation badges, K-9 Teams, and other security technologies.

The Secret Service is responsible for planning, directing and executing federal security operations at designated NSSE's. The Secret Service also provides federal, state and local law enforcement partners who provide substantial, critical support to the protective mission with the necessary guidance and training regarding their role in the overall operational security plans.

The Emergency Preparedness and Response division within the Department of Homeland Security could pre-position some combination of the following assets: the Domestic Emergency Support Team (DEST), Urban Search and Rescue (USAR) teams, national Emergency Response Teams (ERT-N), the Nuclear Incident Response Team (NIRT), the Strategic National Stockpile

and Mobile Emergency Response System (MERS). The specific package will be tailored for each individual event based on coordination with other federal agencies, state and local jurisdictions, available local resources, mutual aid agreements and other event-specific requirements.

B. Special Events Assessment Rating

Coordinated by the Department of Homeland Security/Office of Operations Coordination and Planning (OPS), the Special Events Working Group (SEWG) is the core of an interagency process that involves over 50 Departments, agencies and components of the Federal government. Federal input and recommendations concerning Special Events are provided based on their respective authorities, responsibilities, and fields of expertise. The SEWG is co-chaired by designees from DHS Headquarters, the U.S. Secret Service, FEMA, and the FBI. The SEWG is the single forum that ensures comprehensive and coordinated Federal interagency awareness of and support to designated Special Events.

The Department of Homeland Security (DHS) Special Events Program utilizes the annual Data Call conducted in conjunction with the State, Local, Territorial and Tribal (S/L/T/T) Homeland Security Advisors. The Program provides an objective, calendared framework through which Federal, State and local entities can identify special events occurring within their jurisdictions.

The Special Events Assessment Rating (SEAR) is the single Federal interagency resource used for assessing and categorizing domestic events that do not rise to the level of a National Security Special Event (NSSE). Using a risk-based approach to weigh vulnerabilities and consequences against threats, the SEWG develops the SEAR levels based primarily on event information submitted by S/L/T/T officials in the annual Data Call.

1. SEAR-I: Events of significant national and/or international importance that may require extensive Federal interagency security and incident management preparedness. Pre-deployment of Federal assets as well as consultation, technical advice and support to specific functional areas in which the state and local agencies may lack expertise or key resources may also be warranted. In order to ensure unified Federal support to and appropriate national situational awareness, a Federal Coordinator (FC) will be designated, and an Integrated Federal Support Plan (IFSP) (Matrix of responsibilities for all agencies involved) will be developed.

2. SEAR II: Significant events with national and/or international importance that may require direct national level *Federal support and situational awareness.* The magnitude and significance of these events calls for close coordination between Federal, state, and local authorities and may warrant limited pre-deployment of USG assets as well as consultation, technical advice and support to specific functional areas in which the state and local agencies may lack expertise or key resources. In order to ensure unified Federal support to the local authorities and appropriate national situational awareness, a Federal Coordinator (FC) will be designated and an Integrated Federal Support Plan (IFSP) will be developed.

3. SEAR-III: Events of national and/or international importance that require only limited direct Federal support to augment local capabilities. Generally, state and local authorities adequately support these events; however, the significance of these events generally warrants national situational awareness and, depending on the jurisdiction,

may require limited direct support from specific Federal agencies. In order to ensure appropriate national situational awareness, an Integrated Federal Support Plan (IFSP) may be developed.

4. SEAR-IV: Events with limited national importance that are generally handled at the state and local level. Unusual circumstances may sometimes necessitate the employment of specific Federal resources to address unique needs of a particular event. Existing Federal assistance programs are available to state and local jurisdictions hosting the event for training, exercise, and/or tailored program support.

5. SEAR-V: Events that may be nationally recognized but generally have local or state importance. Federal departments and agencies will receive notice of these events for situational awareness purposes, but in most cases minimal, if any, Federal assets or resources will be expended to assist with management of these events. Federal officials will not normally actively monitor or coordinate support for these events unless specifically requested.

II. DESCRIPTION OF HAZARD

Significant special events may include any type of event where large groups of people are gathered together, regardless of the cause or purpose of the event, where expanded security and other resources are required above and beyond the resources typically available to Local and/or State government. In such instances, event sponsors, in conjunction with Local and State authorities are responsible for coordinating the event and requesting assistance at the Federal level, if necessary.

Special events may be motivated by political, economic or social causes, as in the case of Inaugurals, State of the Union Addresses, and Summit Conferences, or by recreational causes, as with the Olympics and other major sporting events (Super Bowl, World Series, etc.). Special events may also include large holiday events such as the annual Fair St. Louis 4th of July Celebration, where large numbers of people crowd onto the Mississippi Riverfront in St. Louis.

The perception of inherent dangers and threats facing this country and the State of Missouri has changed significantly since the terrorist attacks of September 11, 2001. In keeping with the National Response Framework (NRF), the Missouri State Emergency Operations Plan (SEOP) should also provide a Hazard Analysis consideration section for special events as described herein. The following Historical Statistics Section details some of the potential impacts on security and medical resources that a “special event” could pose for consideration.

Anytime a large number of people are congregated in one area, an incident resulting from just about any of the hazards detailed in this Missouri Hazard Analysis could have devastating impacts. For example, consider the impact a sudden, severe hailstorm could have on the population visiting the aforementioned Fair St. Louis, which well over one million people usually attend each year. A hailstorm such as this struck the north St. Louis County area in April of 2001, causing thousands of dollars of damage to residences and vehicles. This storm produced baseball-size (and larger) hailstones, which killed many pets and nearly all the waterfowl residing at local park ponds. An incident such as this could have devastating impacts if it were to suddenly strike the fairgrounds with over 250,000 people in attendance and without shelter (not to mention the potential impact a terrorist attack incident could impose at such an event). Medical services would likely be overwhelmed with the number of injuries. .

III. HISTORICAL STATISTICS

A. Atlanta, Georgia, Centennial Olympic Park Bombing

On Saturday July 27, 1996, Georgia Bureau of Investigation (GBI) agents in Atlanta were dispatched to the Centennial Olympic Park for what seemed like a routine public disturbance call on the ninth day of the 1996 Summer Olympics. Apparently, some rowdy partygoers had been creating a scene at the event.

By the time GBI agents arrived, the partiers were gone. However, a security guard pointed out another problem: a green knapsack left unattended under a nearby bench. Because of the suspicious nature of the situation, a bomb diagnostic team was called as officers attempted to keep people away from the area without creating a panic. They were unaware that a warning call had been made to 911 emergency dispatchers.

About 20 minutes later, as agents were assessing the situation and continuing to attempt to steer people away from the abandoned bag, it blew up with a powerful explosion. The blast killed one visitor and injured more than 100. All of the law officers at the scene were injured except for one. A Turkish cameraman also died of a heart attack while covering the explosion.

FBI said of this incident, "The fatal bombing in Atlanta was a terrorist attack aimed at thousands of innocent persons gathered at the Olympic Park." This blast was the worst attack on an Olympic Games since 11 Israeli athletes were killed by Palestinian guerrillas at the 1972 Games in Munich, Germany.

B. St. Louis, Missouri, Papal Visit

Pope John Paul II visited St. Louis, Missouri, on January 26 and 27, 1999. This pastoral visit included 30 hours of speeches, parades, prayer services, and a papal Mass for about 104,000 people at the St. Louis America's Center, which filled every available seat in the center, including the Edward Jones Dome and adjoining convention exhibit hall. This Mass is billed as the largest U.S. indoors gathering ever. This event was designated a National Special Security Event.

This 2-day series of events also included a welcome address by President Clinton and ceremonial farewell meeting with then Vice-President Al Gore, and was attended by many state officials including Missouri Governor Mel Carnahan. Event activities were spread throughout the St. Louis metropolitan area, from the Lambert-St. Louis International Airport to the downtown area and the grounds of the Gateway Arch on the Mississippi Riverfront.

This was undoubtedly the largest single "special event" to occur in the State of Missouri in recent years, with security concerns reaching to national and international levels. Close coordination between local, state, and federal law enforcement agencies is required to provide adequate security measures for events like this. The potential for hazards from mass transportation accidents was also elevated for this event, as one quote said, "Seemingly every school bus in the region was enlisted to transport people from suburban pickup points down into St. Louis America's Center for the papal Mass". Fortunately, this event was conducted without any major incidents.

C. St. Louis, Missouri, World Agricultural Forum Conference

The Hyatt Regency Hotel at Union Station in St. Louis hosted the "World Congress" meeting of the World Agricultural Forum May 18 to 20, 2003. The forum brought together agriculture industry leaders and world leaders to discuss the future of global agriculture. Mindful of Seattle, Washington's, experience with violent protestors who disrupted the World Trade Organization (WTO) meeting there in December 1999, St. Louis police were braced for any possible problems that could arise from hundreds or even thousands of protestors descending on St. Louis for this event.

Four Seattle police officers were invited to St. Louis to talk about what happened at the 1999 WTO event, when 50,000 demonstrators overwhelmed 400 Seattle officers. Protestors smashed windows and vandalized cars as police fought back with rubber bullets and tear gas. Washington, D.C., police were also invited to St. Louis to share their experiences with riots during protests of major global conferences in their city.

Although St. Louis police were not anticipating the same level or intensity of violence as in Seattle, they did have intelligence reports that some visitors would be in St. Louis who were involved in the Seattle protests and other demonstrations. Another conference, called Biodevastation 7, was scheduled immediately prior to the World Agricultural Forum (May 16 to 18, 2003) in St. Louis, which involved a gathering of opponents to genetic engineering. An organizer with the group had indicated that 200 to 800 people were expected to attend the Biodevastation 7 conference and that there would be 200 to 2,000 protestors at the World Agricultural Forum.

During this time period, in nearby Creve Coeur, Missouri, extra police were also on hand at the Monsanto property for the annual Creve Coeur Days. Monsanto, an agriculture industry leader, is a host of the annual celebration, which includes carnival rides and game booths on its property. Creve Coeur police coordinated a plan with St. Louis police to gather information about possible protests at this event.

A local international security-consulting firm was in charge of security for the World Agricultural Forum conference. They worked with St. Louis Police and other law enforcement agencies to prepare for possible protests at this event. Close coordination between these agencies helped to ensure that St. Louis was prepared to provide adequate security for the event and the international visitors to the city. Other than a couple of minor incidents between police and activists in the days leading up to the conference, no incidents were reported. A protest outside the conference on May 18 drew only a few hundred demonstrators, all peaceful, and only a handful of demonstrators were present during the event's final two days.

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Probability

Missouri will undoubtedly host future special events, which will require significant security and other emergency planning considerations. The overall probability that a disastrous incident from any cause would occur in conjunction with a designated special event or special security event is considered low to moderate. The probability for an incident to occur during any particular special event is really a function of the hazards previously detailed in this Missouri Hazard Analysis and the probability of the independent occurrences of these hazards. However, "special events" will

unfortunately continue to be likely targets for protests, rioting, and terrorist attacks in the U.S. Refer to the Measure of Probability and Severity discussions in the previous annexes of this document for more specific considerations**.**

B. Severity

The severity of incidents occurring in conjunction with designated special events could range from low to high, depending on many factors. The severity of these incidents will be a function of the number of people attending these events and the type and severity of the specific hazards to affect the events. Considerations of severity could range from a "hoax" bomb scare or terrorist threat where no one is physically injured and without any property damage, to a full-scale disaster affecting a large number of people gathered at one time with mass injuries and property damage by natural, accidental, or terrorist or criminal causes. Refer to the Measure of Probability and Severity discussions in the previous annexes of this document for more specific considerations.

V. IMPACT OF THE HAZARD

As with the measure of probability and severity, the potential impact of hazards occurring in association with any special event must be evaluated as a function of the specific hazard that could cause the impact on a large number of people attending any event. Refer to the Impact of the Hazard discussions in the previous annexes of this document for more hazard-specific impact considerations. Certainly the potential impact of any hazard can be multiplied several-fold when it affects a large number of people all at once.

VI. SYNOPSIS

Adapted from the National Response Framework (NRF): The perception of inherent dangers and complex threats facing this country and the potential consequences they could have on the American way of life has changed significantly since the terrorist attacks of September 11, 2001. These threats cross a broad spectrum of contingencies from acts of terrorism to natural disasters to other man-made hazards (accidental or intentional). Because all carry the potential for severe consequences, these threats must be addressed with a unified national effort. A new paradigm for incident management is required. This philosophy has been the mandate for change leading to development of the NRF.

This section is being added to the Missouri Hazard Analysis (Appendix 5 to the State Emergency Operations Plan) in keeping with the NRF. The NRF is being designed as an "all hazards/all disciplines" plan and considers hazards under the full range of possible contingencies, including:

- Natural Disasters
- Accidents
- Civil/Political Incidents
- Terrorist/Criminal Incidents
- Significant Events/Designated Special Events.

Significant special events are considered any type of event where large groups of people are gathered and expanded security and other resources are required above and beyond the resources typically available to local or state government. Special events may be motivated by political, economic, or social causes, as in the case of Inaugurals, State of the Union Addresses, and Summit Conferences, or they may be motivated by recreational causes as with major sporting events or designated holiday events.

Regardless of the purpose or cause, special events will place a large number of people in one area at one time. Anytime people are crowded together in one place, an incident resulting from just about any of the hazards detailed in this Missouri Hazard Analysis could have compounded and devastating impacts.

In such instances, event sponsors, in conjunction with Local and State authorities, are responsible for coordinating the event and requesting assistance at the Federal level, if necessary.

Local and State authorities are responsible for:

- Coordinating requirements from the organization sponsoring an event
- Determining resource shortfalls and submitting resource requests, through the existing structures and mechanisms, to the national level for consideration.

Event sponsors are responsible for:

- Developing concepts for conducting the event
- Identifying resource requirements necessary to support the event
- Submitting resource requests to Local and State governments for consideration.

VII. MAPS OR OTHER ATTACHMENTS

None.

VIII. BIBLIOGRAPHY

The U.S. Department of Justice (DOJ). 1998. "Eric Rudolph Charged in Centennial Olympic Park Bombing," press release dated Wednesday October 14, 1998, available electronically at www.usdoj.gov/opa/pr/1998/October/477crm.htm.

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